Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIV. NEW YORK, SATURDAY, DECEMBER 17, 1904. No. 25.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the
McGRAW PUBLISHING CO.
114 LIBERTY STREET, NEW YORK.
TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

NOTICE TO READERS
WHO ARE NOT SUBSCRIBERS.

ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico - - - - - -	Per year, $3.00
Foreign Countries, within the Postal Union - - - - - - - -	6.00
Great Britain and Ireland - - - - - - - - - -	25 shillings
Germany - - - - - - - - - - - - - - - -	25 marks
France - - - - - - - - - - - - - - - -	31 francs
Single copies - - - - - - - - - - - - - - -	.10

Remittances for foreign subscriptions may be made through our European office.
In requesting your address changed give OLD as well as new address.

Copyright, 1904, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, DECEMBER 17, 1904.

CONTENTS.

Editorial	1037
The Engine Builders' Association of the United States	1040
Electric Meter Litigation	1040
Western Union Must Remove Pennsylvania Poles	1040
Navy Wireless	1040
Development of Electric Power Behind Niagara Falls	1041
Fundamental Principles of Power Equipment for Telephone Exchanges. By B. D. Willis	1043
Special Methods for Locating Faults on Electric Cables. By Henry W. Fisher	1045
Deficient Facilities for Stock Reporting	1046
On the Theory of the Regulation of Alternators. By C. F. Guilbert	1047
Recent Station Equipment of the Worcester Electric Light Co., Worcester, Mass.	1050
The Law Relating to the Escape of Electricity. By W. Valentine Ball, M. A., Barrister at Law	1051
Typical New Telephone Building at Newton, Mass.	1054
The Present Relations of Physics and Electricity	1055
Technical Society of the Pacific Coast	1056
Revision of the National Electrical Code	1056
Recent Electrochemical Developments	1057
Cooper Hewitt Converter	1058
New Telephone Patents	1059
Pumping in Irrigation Work	1059
Preparations for the Colorado Lighting Convention	1060
Newspaper Science	1060
Annual Meeting of the New York Electrical Trades Society	1061
Fourth Annual Convention of the Interstate Independent Telephone Association	1061
Current News and Notes	1062
LETTER TO THE EDITORS:	
Niagara Electrical Development. By Chas R. Downey	1063
Digest of Current Electrical Literature	1064
Westinghouse Oil Circuit Breakers	1068
Apparatus for New Power Plant at Baltimore	1069
Test Telephones	1069
Electrical Development in San Francisco	1069
News of the Week	1070
Moonlight Tables for 1905	Supplement

MOONLIGHT TABLES.

This year, as for many years past, Mr. H. W. Frund, the well-known central station manager, has prepared for us moonlight tables for street lighting work, to be used in 1905. With the present issue we furnish these tables in the wonted form of a supplement. We are glad to know that this effort is very much appreciated by our numerous central station readers. Extra copies may be obtained on application to the business department of this journal.

It would interest some of our readers greatly if they knew how wide the range of variation is in possible lighting schedules. The National Electric Light Association lists in its lighting statistics seven standard schedules with 152 variations. There are certainly more than that extreme number of changes on which city contracts are based, a fact often forgotten by people who quote rates from one city to apply in arguments elsewhere.

THE NATIONAL ELECTRICAL CODE.

On Wednesday, the 7th of December, the Electrical Committee and representatives of the National Board of Insurance Underwriters held their annual meeting in New York. The meeting was well attended, and a number of electrical engineers were present. The principal object of the meeting was to discuss and vote upon certain proposed amendments in the National Electric Code of Insurance Rules governing electric installations in insured buildings. Satisfactory conclusions were reached. Some difference of opinion has been recently manifested between the electrical committee of the Insurance Underwriters on the one hand and electric lighting or power interests on the other. In a certain sense such opposition between these interests is as inevitable as that between buyers and sellers, or between capital and labor. The insurance men represent capital invested in insuring buildings against fire. This capital is in the aggregate very large. It is generally admitted that the danger of fire from electric lighting is less than from gas or oil lighting, and this is, we believe, indisputable when the electric plant is properly installed. Nevertheless, there must be some small fire hazard from even the most approved system of electric installation, and the hazard may become large when the electric installation is careless or defective. It is, therefore, inevitable that those who insure buildings against fire shall dictate the conditions under which their money shall be placed at risk. Under approved conditions of installation their terms will be low. Under risky or unapproved conditions, their terms will be higher. As against this the dictation of conditions in equipment is necessarily onerous to the contractors who install the plant. The rules give some bother to conform to, even if they involve no extra expense. Consequently, the insurance interests and the electric installation interests naturally come into opposition.

On the other hand, however, the insurance interests and the electric interests are one and the same in so far as concerns their joint attitude toward the public. Each endeavors to serve the community. The one tries to diminish the destruction of property by fire. The other tries to spread the advantages of cheap and convenient light or power distribution. The insurance men do service to the electric interests by making the installations more durable and reliable. Consequently, both parties are mutual friends so far as they jointly serve the public. Without the rules, electric installations might often be so carelessly installed as to lead to frequent fires and throw discredit on electric industry in the public mind. It is generally admitted that

the electric industry owes much to the safeguarding that the rules have brought. It is of great importance to all interests that the National Code should be strengthened and upheld. Even if it were true that grave imperfections existed in the Code, nevertheless if the Code fell into disuse we should necessarily revert to the prior intolerable condition in which there existed a number of different codes in different parts of the country; so that there would be perpetual uncertainty as to whether an installation would or would not be accepted at a low insurance rate by the insurance inspector. While, therefore, a certain amount of opposition is inevitable between the electrical and the insurance industries, just as between buyers and sellers, this ought not to prevent harmonious action between them. There should clearly be one, and only one, National Code of Insurance Rules. It should, of course, be fairly understood that the rules are demanded by the insurance interests, and are complied with, or acquiesced in, by the installation interests.

The Location of Faults in Subterranean Cables.

Mr. H. W. Fisher's article on page 1045 of this issue emphasizes the importance of determining accurately the resistance of subsidiary resistances in the circuit of a faulty cable under localization test. Even since insulated wires were first used, they have been liable to become faulty, and the faults have been the subject of localization tests. When, as ordinarily occurs in a cable of large conductor, the fault consists of a leak, or partial ground, the object of the test is to determine the resistance of the conductor up to, and inclusive of, the resistance of the leak. In all cases the accuracy of such tests is much greater when the test can be made from both ends of the faulty conductor, by one and the same observer, i. e., when both ends of a faulty looped conductor can be brought to the measuring apparatus.

The precision of a loop test is naturally affected by a variety of conditions, but, other things being equal, it increases with the ratio of the resistance of the unit length of conductor to the resistance of the fault. Consequently, the precision in distance with which the location of a fault can be assigned, on the average, increases, for a given resistance of leak, with the resistance per foot of the conductor. A high-resistance small conductor permits of a shorter average distance between the assigned and actual locations of the leak than a low-resistance large conductor. Thus, in submarine cable telegraphy, a standard conductor for short cables has a cross-section of about 6,000 circular mils, so that one-hundredth of an ohm of error in localization only involves an error in length of about six feet. But in electric power cables having a cross-section of, say, 500,000 circular mils, the same magnitude of error in the localization test would represent a length of about 500 feet. It is evident that with the small conductor, thousandths of an ohm are of insignificant importance; while in the large conductor thousandths of an ohm are equivalent to fifty-foot lengths. The increased accuracy called for in localization tests of heavy conductors must be derived, at least in part, from an increase in the strength of the testing current, and this in turn requires a fairly low resistance in the leak.

Mr. Fisher's article relies, in the main, upon the Murray and Varley loop tests, as these have been known for many years. It suggests a number of detailed measurements, however, which are particularly applicable to electric light and power cables, where every thousandth of an ohm in leads, or in connections, may appreciably affect the precision of the localization. The difficulties referred to are due to the presence of leads connecting the testing apparatus to the cable or of a dissimilarity between the two conductors making up the loop. These details are of great practical importance, and the rules suggested are valuable as representing the results of experience.

Electrometer Methods of Testing.

The method of testing electric insulation by electrometer consists in charging the insulated conductor to a suitable potential, as indicated by the electrometer, and then determining the rate of fall of potential due to leakage. This method is, at least, in no more or less crude form, the oldest found in the literature of the art. It was known at least two hundred years ago. Frictional electric machines were, at an early date, provided with a pair of diverging pith-balls, whose rate of collapse indicated the rapidity of electric leakage and loss of charge. This electrometer method has recently been revived for an entirely new purpose. The object of the test is now to determine how good a conductor a given volume of gas may become, after being subjected to the emanations of radium, or to radioaction.

An electrometer consisting of a vertical plate and appended gold-leaf, is supported insulated in a gas chamber, and charged by an extraneous electric source, in such a manner that the gold-leaf projects from the plate. An optical system is arranged outside of the chamber, so as to measure the rapidity of fall of the gold-leaf, and thus the rapidity of loss of charge. A measured quantity of the gas to be tested is aspirated into the chamber. This test volume of gas has been previously subjected to the action of a measured mass of radioactive substance. The greater the degree of radioactivity in the substance, the greater the degree of ionization of the gas exposed thereto, and the greater the electric conductivity of the gas. Of course, even a highly radioactive substance produces only a low conductivity in air, or other gas, in comparison with the conductivity of electrolytes, and yet lower in comparison with metals. For such conductivities, electrometer methods are convenient. As the result of a number of tests conducted in this manner on air long exposed to measured quantities of uranium compound, it is stated that the radioactivity is always proportional to the quantity of uranium present. This proportionality seems to be found for uranium minerals taken from very different parts of the earth's surface.

The hypothesis presented by J. J. Thomson and Rutherford is that radium may be a product of the destruction of uranium. In other words, uranium atoms have a certain average lifetime. An uranium atom would make even Methusaleh, or the Wandering Jew, turn green with envy, since its life is about 1,000,000 years. Just how the uranium atom dies, on this hypothesis, is, of course, yet a mystery. It is supposed, however, that it dies by explosion. Speaking superficially, and not entering the domains of biology, animals die rather by collapse than by explosion. If, however, the explosion of an uranium atom which results in its death is assumed to take place inwards, the process of explosion may also be regarded as equivalent to collapse. In dying the uranium is supposed to give birth to a radium atom, and also possibly to some other disintegration product or products. The radium atom, in its turn, lives for about a thousand years, and then dies in its turn, also by explosion, giving birth to radium emanation possessing different and remarkable properties. The emanation lives but a short time and in dying gives birth to something else, and so on for about half a dozen generations in all, as thus far recognized.

In a certain sense inorganic matter may be regarded as dying, when it changes its chemical combination; i. e., when an atom of a chemical substance changes its union with other atoms. Thus carbon, in the form of coal, may be looked upon as dying, when it combines with oxygen at a high temperature in a furnace. But such chemical processes, as they are at present understood, do not involve a disintegration of the atom. The substance dies perhaps, but the new substance contains the old atoms which have only altered their external relations. Inside each atom is just as it was before

the change. In the disintegration which uranium is supposed to undergo, the atom dies. It is not a change in atomic combination that occurs, but a change, or disintegration, in the structure of the atom. According to this recent theory uranium and its derivatives are the only materials yet known to us, whose atoms die. In the organic world birth of a new organism occurs prior to the death of the parent organism. In a few instances the two phenomena may be closely associated in time; but in most cases the death of the parent has no direct connection in time with the birth of the offspring. In this atomic world of the uranium family, however, the birth of the offspring can only occur at the death of the parent. Moreover, the process seems, according to the theory, to be exothermic from an energy standpoint. An uranium atom as the sire is a relatively heavy atom, with 239.5 times the mass of a hydrogen atom. He contains a relatively enormous amount of energy. When he dies his son, radium, inherits at least a large share of the energy stock after paying for what is lost in the funereal explosion of the parent. When radium dies more energy goes off in explosion, but the emanation still possesses great energy wealth. Each generation, however, possesses less and less wealth, until the last generation becomes comparatively poor. Does it ever stay so, or go back from "shirtsleeves" to wealth again?

THE PRACTICAL SIDE OF WIRELESS TELEGRAPHY.

A very pretty example of the everyday usefulness of wireless telegraphy turned up the other day when an incoming Cunarder was reported in Boston from a point nearly 800 miles from that port. She was picked up by the Cape Race wireless station and the ordinary wires did the rest. Notice of the probable hour of her arrival in spite of delays which she had experienced was thus given almost two days in advance, to the great convenience of everybody concerned. The same thing will be regularly repeated in all probability, and thus the gap of isolation on the transatlantic voyage will be greatly narrowed. Quite aside from long-distance feats, the art of wireless telegraphy can thus be made immensely more useful to mankind than it has yet been. It is not at all necessary to send wireless messages across the Atlantic, for we have the cables already, although active competition with the wireless system would doubtless be of some advantage. With the system as we have it to-day, splendid work has been done over distances great enough to be immensely useful, and even if unforeseen difficulties block regular transmission half across the world, we may well be thankful for what we already have. In the Russian-Japanese war the system has shown its immense value in naval operations. The conception of a blockading fleet being held at a safe and convenient base until warned by its scouts that its presence is needed is distinctly worthy of this twentieth century of ours. But the uses of the system in peace will prove still more important even with greater limitations in distance than are likely to prove permanent. The ocean is no longer an unbroken waste of waters, and by taking advantage of capes and islands the greater part of it can be covered by a wireless system without requiring transmission over more than a few hundred miles in any single stretch.

A regular working radius of 500 miles would work wonders in keeping in touch with navigation, particularly when supplemented by the existing network of cables. Stations in the Azores, the Cape Verde Islands, Bermuda and the Windward Islands would keep watch over practically the whole Atlantic in co-operation with the stations and cables now existing. Save for short stretches the great tracks through the Indian Ocean could be similarly guarded by a few well-placed stations. The major part of the Pacific could be likewise covered, and indeed save for the southernmost stretches of the Indian Ocean and the northward courses on the Pacific, there would be few gaps in any of the important paths of navigation. A moderate extension of working distance would close up many of these so that a properly equipped steamer could keep within hailing distance of land most of the time. Even if we should soon get regular service across the Atlantic, it does not necessarily follow that steamers could conveniently carry the equipment necessary for a response to the land stations from midocean. Hence the great usefulness of subsidiary stations on distant points and on isolated islands whence messages could be relayed or transferred to the cables as might be convenient. In the long-distance work which has already been done it has been regularly possible to get shore signals long after it became impossible to reply. One of the serious practical problems in wireless telegraphy to-day is to produce a ship's equipment capable of sending messages not necessarily as far as the shore stations can, but still over much greater distances than are now practicable. It is easy enough on a modern steamer to get an electrical outfit of ample power, but adequate antennæ are quite another matter. Something has been done with kites in this line and the work is well worth following up. To get signals of any power with short antennæ has proved to be a difficult proposition, although it is not yet quite clear whether the difficulty lies with need of absolute height from the surface, intrinsic need of longer waves than can be obtained without resorting to very long antennæ, or an inability to get adequate energy into short waves by the use of present devices. If the last-named is the real difficulty there is good chance of escaping it, but if either of the other considerations is important the way out is not so clear unless one resorts to kites. Most annoying of all would be the requirement of a large vertical height.

From all that has been made public it seems that the present range of action from a moving ship is far too small to give wireless telegraphy anything like the scope that is needed for regular use. If the combatants in the Far East had been equipped with apparatus of several hundred miles' range, the Vladivostok squadron would have come to grief much sooner than it did. In spite of the remarkable work done during the cruise of the *Carlo Alberto* and other long-distance feats, we have still a very imperfect idea of the limitations which keep down the actual working radius of action and of their causes. Once discover the reason for a limitation and the first important step toward removing it has already been taken. One of the questions which must be answered is the following: Given the ability to signal clearly and to receive clearly over a distance, let us say, of 100 miles, how steadily do these favorable conditions persist, and when trouble comes is it due to causes in the apparatus or external to it? If the former, one may confidently look forward to the avoidance of trouble; if the latter, then a certain amount of trouble must be taken for granted as likely to persist. In either case the system is still capable of very great usefulness, but the line of its development will be changed according as one or the other set of causes is operative. At all events we are measurably near now to having a fairly complete coastline series of stations which will be of immense service to navigation. Here the important thing is not so much radius of action as completeness in covering the coast. Indeed, for safety signals from the coast a long range is positively disadvantageous in most cases, as tending to confuse the navigator in locating the signals. The next step will be the use of more powerful apparatus for keeping in touch with the liners, as in the case we mentioned at the start, and the next is the building of a network of stations to extend this touch over areas as great as possible. Wireless telegraphy is getting down to business, slowly it is true, like most new things, but it is evidently getting there, and the next few years will see very important developments.

The Engine Builders' Association of the United States.

The Engine Builders' Association of the United States held its meeting in New York at Sherry's on Friday and Saturday, December 9 and 10, with President C. S. Gates in the chair. The meeting of Friday was open to the public, but that of Saturday was an executive meeting at which members only were in attendance. At this latter meeting the following officers were elected:

President, C. A. Gates (re-elected); vice-president, T. C. Wood; secretary, N. B. Payne; treasurer, Arthur L. Merriam. The members of the council are: Walter C. Kerr, F. S. Bagg, N. B. Payne, C. A. Bonsall, H. C. Nichols and J. I. Lyle.

Four papers were read at the opening meeting on Friday as follows: "Costs," by Mr. C. M. Lauer; "The Steam Turbine," by Mr. F. C. Bates; "Employers' Associations," by Mr. Charles L. Eidlitz, and "Salesmanship as an Applied Science," by Mr. R. U. Conger. Mr. Lauer advocated the separation of labor and machinery costs in making up the manufacturing cost of an article. Among the details of the system proposed was that the hourly labor charge should be 50 per cent. greater than the rate actually paid to the workmen, and that the hourly machine cost should be based on the investment, proportion of a shop floor space occupied, wear and tear on the machine and other factors actually entering into the cost of operating the machine, the cost of labor being excluded.

The paper of Mr. Bates presented the merits of the Curtis type of steam turbine, and incidentally sketched the principal features of the Parsons, De Laval and Rateau types. The author laid stress upon the advantages of the Curtis turbine with respect to generator construction and speed.

The paper by Mr. Eidlitz excited lively interest, which at times was manifested in applause. In an association of employers he considered that open purses are absolutely indispensable for success, in which respect a lesson may be taken from the labor unions. Such an association must have at its head men well fitted for the responsibilities of the positions and for good results must have the loyal support of every one, and especially of their business competitors in the association.

Mr. Conger presented his paper extemporaneously and treated in an interesting manner the various factors entering into salesmanship, which branch he considered is practically a science. He also sketched the various qualifications necessary in a salesman for success in his calling.

Prof. Sweet reported the results of a mission to Washington of a committee appointed to oppose any legislation in favor of the metric system. He stated that the committee, which consisted of himself and Messrs. William Kent and W. M. McFarland, had been unable to induce the Government committee to agree to report along the lines which they advocated. He believed, however, that the arguments of the committee had prevented the Government from making a favorable report, but considered that the matter would undoubtedly come up again next year. Prof. Sweet concluded with some arguments against the substitution of the metric system for the English system in this country, and was emphatic against any legislation making the adoption of the system compulsory.

Electric Meter Litigation.

The Circuit Court of the United States for the District of Indiana has handed down a decision in a case involving three patents granted to Thomas Duncan and which had been assigned by him to the Siemens & Halske Electric Company of America, the defendants being the Duncan Electric Manufacturing Company. It was claimed that a meter manufactured by the latter company infringed the Duncan patents. The court held that while on account of having been the inventor, Duncan is estopped from contesting the validity of the patents in suit, he may show that his meter does not infringe the patents assigned.

A large number of claims in the several patents were involved in the litigation, all relating to matters of detail. In one instance it was held that the Thomson-Houston Company had used the exact construction described in a claim at issue, and also the exact construction shown in the defendant's machine, and consequently the invention cannot be considered to consist in a departure from the prior art. In the case of a group of other claims it was held that a device which has within itself provision for changing the relation of the parts without taking it apart or altering it in any way, is not infringed by a device which has no such provision, but which can only be adjusted by taking it apart and putting it together again after adding to or taking from some other part of the device. In the case of some further claims relating to adjustment, it was similarly held that since the mechanism of the defendant must be disassembled and reassembled to make a change, this cannot be considered an adjustment.

The bill of the plaintiffs was dismissed.

Western Union Must Remove Pennsylvania Poles.

At Washington, D. C., on December 12, the Supreme Court of the United States decided the case of the Western Union Telegraph Company vs. the Pennsylvania Railroad Company, involving the right of the railroad company to remove the telegraph company's poles from its right of way, in favor of the railroad company. The opinion was handed down by Justice McKenna. The court held that the Congressional act of 1866, which controlled in the case, does not grant eminent domain to telegraph companies over the private property of railroad companies.

Justice Harlan delivered a dissenting opinion, holding that the act of 1866 gives to telegraph companies the unequivocal right to construct and operate lines not only upon the public domain, but along any post road of the United States, and he contended that if to-day's decision was to stand the United States Government could not itself enter upon the rights of way of railroad companies. Justice Brewer concurred in the decision, but said he did so because he considered that the points in controversy had been determined in previous litigation.

The case involving the right of the railway company to remove the telegraph company's poles originated in New Jersey. Justice McKenna, in his opinion, said that the telegraph company contends that the necessary implication from the provisions of the act of 1866, permitting telegraph companies to use post roads, is that telegraph companies may appropriate for their poles and lines a part of the rights of way of railroads *in invitum* upon paying just compensation. In other words, that the act invests telegraph companies with the right of eminent domain.

"It follows from these views that the act of 1866 does not grant the right to telegraph companies to enter upon and occupy the rights of way of railroad companies, except with the consent of the latter, or grant eminent domain."

The Supreme Court also decided the case of the Western Union Telegraph Company vs. the Pennsylvania Railroad Company, involving the right of the telegraph company to condemn a part of the railroad's right of way in Western Pennsylvania and appropriate it for its lines. The decision was against the telegraph company. The contentions in this case were practically the same as in the other.

Navy Wireless.

The Navy Department has closed a contract for the installation of Fessenden apparatus on the battleship *Alabama*. This installation is guaranteed to operate satisfactorily with similar apparatus on the battleship *Illinois* at a distance of 250 miles. If the test is successful navy officials say it will surpass any previous records of communication between ships, although land to ship communication has been established at greater distances. In all kinds of weather, when the ships are merely cruising and when they are engaged in battle exercises with all the guns firing and when they are encountering an atmospheric interference of the "enemy's" wireless, there will be constant effort to employ this means of communication.

Authority Over Trolleys.

According to newspaper reports, Attorney-General Hamlin, of Illinois, has given an opinion that the Railroad and Warehouse Commission has jurisdiction over all crossings of every kind whether between street railways, interurban railways, steam railroads or one with the other. An attempt will be made by the commission to force interlocking of crossings of interurban electric lines with other electric lines and with steam railroads.

Development of Electric Power Behind Niagara Falls.

WATER diverted from the Niagara River in the midst of the Canadian rapids and discharged back of the Horse Shoe Falls is to develop 137,500 hp. Such is the plan that is now being pushed toward completion by the Toronto & Niagara Power Company near the Canadian bank of the river in Queen Victoria Park, Niagara Falls.

For this development a long diverting dam is run from the river bank out to the swiftest and deepest rapids, a part of the water thus caught is dropped through penstocks to vertical turbine wheels at the bottom of a pit 150 ft. deep, and is then discharged through a straight tunnel under the river at a point beneath the center of the Horse Shoe Falls. At the tops of the vertical wheel shafts in a station over the pit and close to the river bank are the direct-connected electric generators. Owing to the curved form of the Canadian bank of the river the generating station is directly back of the center of the Horse Shoe Falls, on a line nearly at right angles to their crest. For this reason the perfectly straight tunnel beneath the river discharges near its thread at the foot of the falls. This tunnel gives the shortest possible line of discharge and penetrates the mystery behind the great sheet of falling water.

Above the rapids that mark the descent of the Niagara River to its final plunge its low water elevation is about 553 ft. greater than tide level. In the chain of cascades that lead down to the falls the river drops some 55 ft. while flowing less than three-fourths of a mile along the Canadian bank. At a point on this bank about halfway between the upper line of breakers and the crest of Horse Shoe Falls the diverting dam of the company projects into the river. Near the bank and to a distance of about 200 ft. out into the rapids the direction of the dam is nearly at right angles with the river current, and then the direction changes to parallel with this current. From this angle in the diverting dam to its outer and upstream end the length is about 650 ft., giving a total length of more than 850 ft. This diverting dam runs out into water that is as much as 14 ft. in depth, and the crest of its outer portion has an elevation of 533 ft., or about the normal river level at the upstream end. Along the downstream portion of the diverting dam the crest is beneath the normal level of the water in the forebay, and acts as a discharge weir for floating ice or other objects. Between the diverting dam and the ice racks and gates on the river side of the power station there are two lines of masonry ice piers or booms with arches beneath the level of water in the forebay. At the water line each of these booms is swept along its outer face by a cross current that carries floating ice over the weir section of the diverting dam. In the forebay side of the power house, just behind the gates there are set the upper ends of eleven steel penstocks with their center elevations at 503 ft., or 35 ft. below the main floor of the power house and 30 ft. under the water level in the forebay. Each of these penstocks is about 10.5 ft. in diameter and terminates at the bottom of the wheel pit, down

FIG. 2.—PART OF FOREBAY, TORONTO & NIAGARA POWER CO.

which they drop in the case of a pair of vertical turbine wheels rated at 12,500 hp. Five of these pairs of wheels discharge through draft tubes into a branch tunnel a little beyond one side of the wheel pit and the other six pairs of wheels discharge into a similar tunnel near the other side of the wheel pit. The two branch tunnels just named unite in a common tail-race tunnel at some distance from one end of the wheel pit, and this tunnel runs in a straight line under the river to its vent behind the Horse Shoe Falls. At the tops of the vertical shafts of these turbine units the electric generators are mounted in the power station that is located over the wheel pit.

The power house when completed will be a stone building of rather classic exterior design, about 70 by 500 ft. in plan and 40 ft. high. In location the power house and the wheel pit beneath it are in large part beyond the original shore line of the park, and occupy space that was formerly in the river bed. The site thus chosen is just downstream from the intake of the Ontario Power Company and a little above the intake and power house of the Canadian Niagara Power

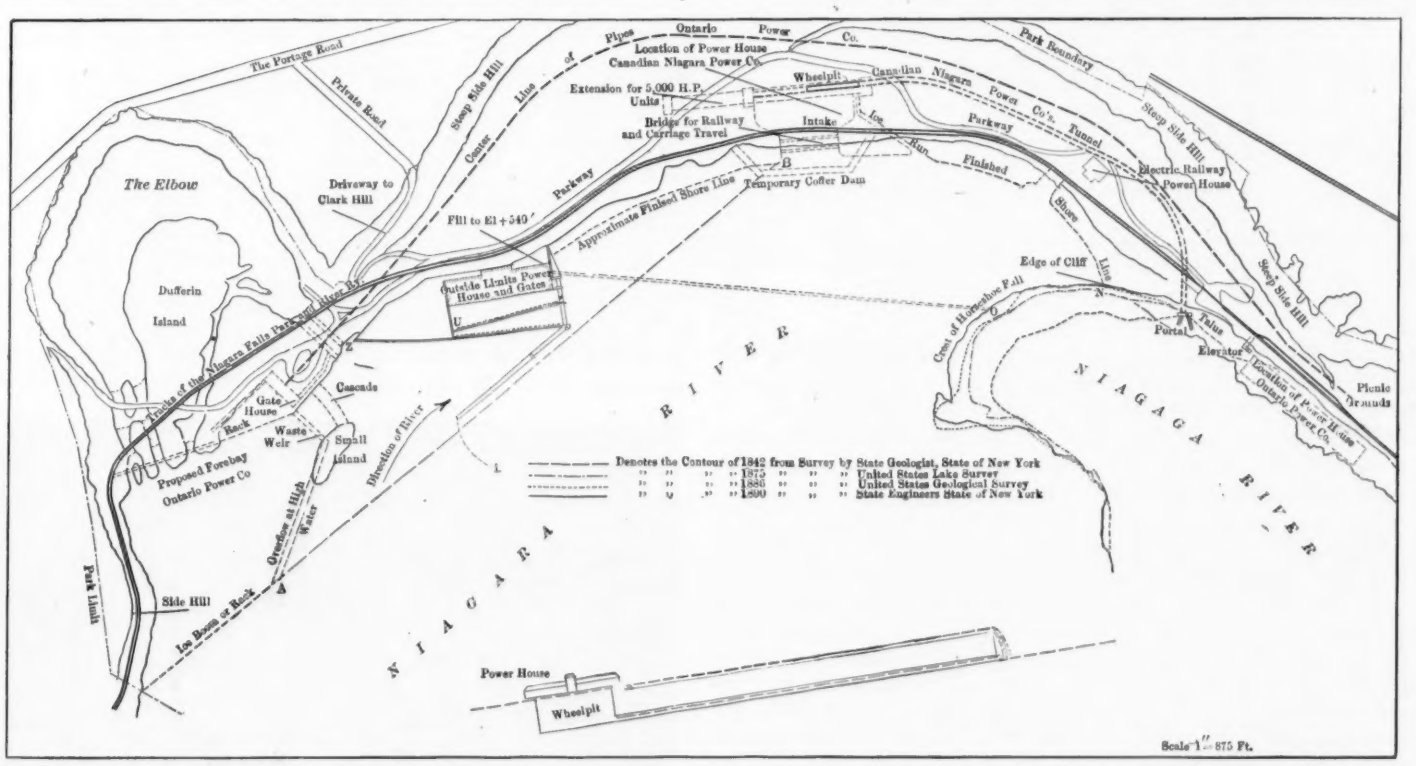


FIG. 1.—GENERAL MAP SHOWING SITES OF PLANTS OF CANADIAN NIAGARA POWER CO. AND ONTARIO POWER CO.

Company. Beneath the main floor of the power house the wheel pit of the Toronto & Niagara Power Company is excavated mostly through limestone to a depth of 150 ft., or from an elevation of 538 ft. down to 388 ft. above tide water. In plan the wheel pit measures 416 ft. long and 22 ft. wide inside of its linings, and thus has an area of 9,152 sq. ft. The eleven pairs of turbines in the pit, rated at 12,500

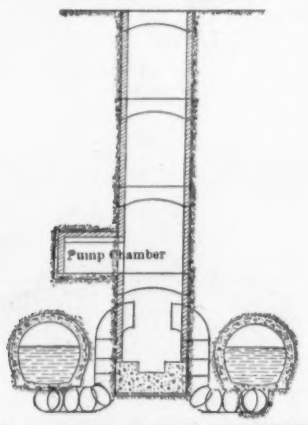


FIG. 3.—CROSS-SECTION OF WHEEL PIT.

hp each, have an aggregate capacity of 137,500 hp, and this gives the very large figure of nearly 15 hp per sq. ft. of pit area. Each vertical turbine shaft on its way up to the power house floor passes through two heavy concrete arches that span the wheel pit and furnish support for the thrust bearings. These concrete arches for the shafts are arranged across the pit in two horizontal rows at elevations 439 and 481.5 ft. respectively. At the bottom of the wheel pit the turbines are set on the solid limestone floor and undesirable vibration will thus be reduced to the least possible amount.

A novel construction of the tail-race tunnel is resorted to in order to obtain a dry wheel pit and to inspect or repair a part of the turbines while others are in operation. For this purpose the tail-race consists of two separate tunnels at its upper end, and one of these tunnels lies on each side of and beyond the wheel pit. From each of five of the eleven pairs of turbines a draft tube goes to the branch tunnel on one side of the pit, and from each of the other six pairs of turbines a draft tube goes to the branch tunnel on the other side of the pit. All of the draft tubes enter the bottoms of their tunnels and are thus constantly sealed with water when in operation. From the row of eleven pairs of turbines the draft tubes from alternate pairs go to the same branch tunnel. At a point 165 ft. from the lower end of the wheel pit toward the outlet behind the falls the two branch tunnels unite to form a single tail-race. From this point of union to its discharge end the length of the tunnel is 1,935 ft., with a fall of 5.5 ft. in 1,000, so that the total drop in this part of the tunnel is about 10 ft. Above its point of juncture with the main tunnel each branch tunnel is provided with a gate which can be closed so that the turbines connected with either branch may be shut down and inspected while the turbines connected with the other branch are in operation, without any trouble with back water. The tail-race tunnel has its roof in shale and is lined over all except the lower 300 ft. of its length with two layers of hydraulic pressed brick backed with concrete. For 300 ft. back of the mouth of the tunnel its lining consists of concrete rings laid in lengths of 6 ft. As the falls wear back the face of the cliff at the mouth of the tunnel these concrete rings will fall off at their vertical joints. Through its lower 1,755 ft. of length the tail-race tunnel is 17.5 ft. wide at the bottom, 23.5 ft. at the widest part and 26.13 ft. high. A steel gallery will be suspended from the roof of the tunnel along its entire length, and it will be provided with electric lights so that inspection can be made even when the turbines are in operation. The two branch tunnels have their centers 38 ft. respectively on either side of the center of the wheel pit, and each is separated from it by a wall of rock and masonry about 16 ft. thick. The bottom of each branch tunnel is some feet lower than the bottom of the wheel pit, but when all of the power units are in operation at full load the water in these tunnels will rise somewhat above the level of the wheel pit floor. As there is no open connection between the wheel pit and tunnels below the high water level in the latter at full load, the pit remains dry under normal conditions. If, as sometimes happens, there is a very large rise of water in the gorge below the falls its effect by filling up the tunnel will simply be to decrease the effective head on the turbines, without filling the wheel pit.

While the water elevation of about 533 ft. in the forebay is 145 ft. above the bottom of the wheel pit, the effective head of water on the turbines is about 143 ft., because of friction losses and the rise of water in the branch tunnels during operation at full load. It is

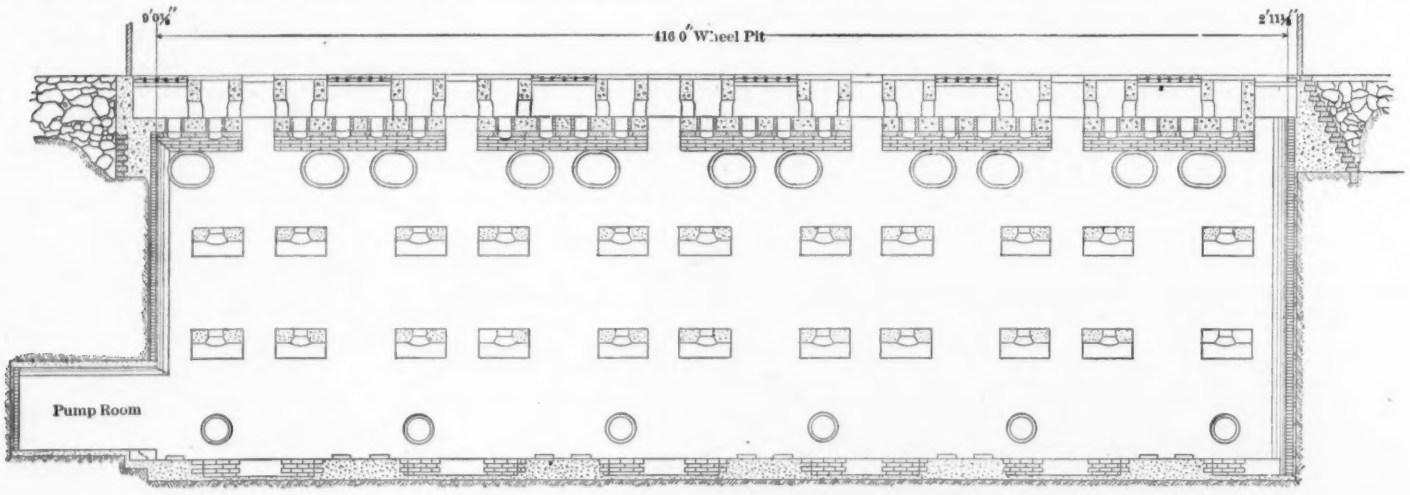


FIG. 4.—LONGITUDINAL SECTION OF WHEEL PIT.

estimated that the eleven pairs of turbines when fully loaded will draw 700,000 cu. ft. of water per minute from the forebay, but the

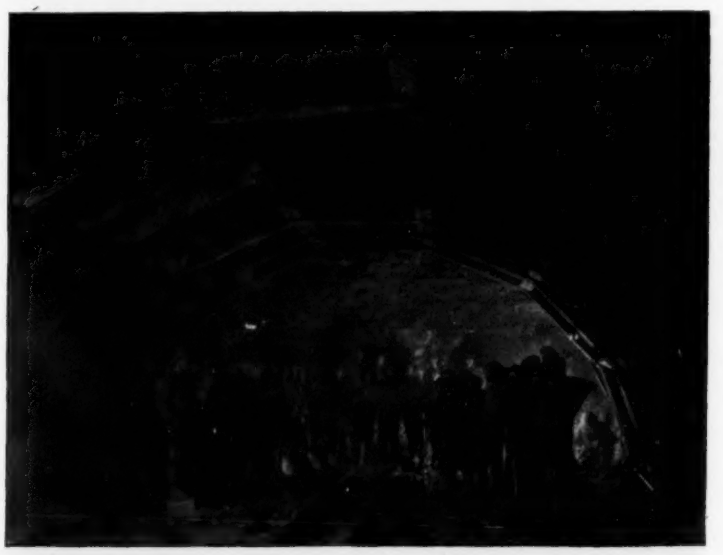


FIG. 5.—TUNNEL UNDER NIAGARA RIVER, TORONTO & NIAGARA POWER CO.

diverting dam of the company has the capacity to gather in from the river as much as 1,800,000 cu. ft. per minute. This excess of capacity gives a high degree of security against future low water from any

cause, and furnishes a large discharge over the waste ways to carry off ice.

At one end of the wheel pit near its floor level is the space excavated in the rock to contain the oil pumps for the bearings of the shafts and turbines. Each of the vertical turbine shafts that extend up into the generator room above the wheel pit is hollow, about 115 ft. long, and has a speed of 250 r.p.m. On the top of each of these shafts there will be mounted a generator rated at 10,000 hp, 12,000 volts, 60 cycles, three-phase, and made by the General Electric Company. There will be eleven of these generators and each will carry its own exciting dynamo at the end of its shaft. In this way the use of small penstocks and water wheels for exciting dynamos is avoided and each generating unit is rendered independent of all others. While a part of the energy from these generators will probably be distributed to manufacturing plants on land owned by the company along the Welland River, at distances of three to four miles from the power house, a large block of the energy will go to Toronto by a transmission line around the head of Lake Ontario that passes the city of Hamilton on its way. The nearby distribution of power will be carried out at about 12,000, the generator voltage, but for the trans-

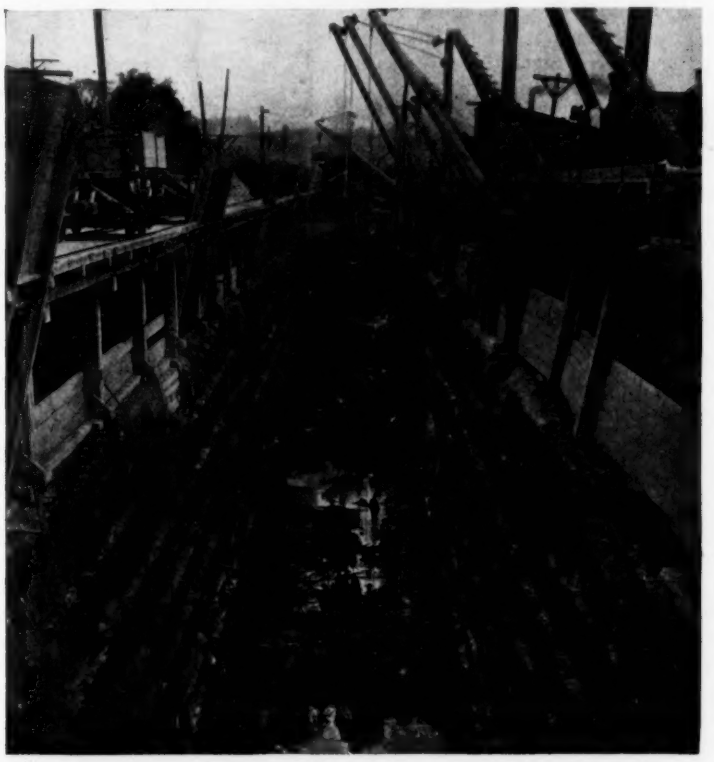


FIG. 6.—137,500-HP WHEEL PIT, TORONTO & NIAGARA POWER COMPANY.

mission to Toronto a much higher pressure will be obtained by transformation. For this transmission a right of way has been purchased from the park limits near the power house to the outskirts of Toronto, a distance of 75.5 miles by the line. It is the intention that this right of way shall serve not only for the transmission line, but also for an electric railway that will afford real rapid transit between Toronto and the Niagara frontier. For this interesting development Mr. F. S. Pearson is consulting engineer, Mr. Hugh L. Cooper chief hydraulic engineer and Mr. Beverley R. Value, to whom we are especially indebted for the above facts, is resident engineer in charge of the work.

The Highest Dam.

The San Luis Valley Irrigation, Land & Power Company, of Colorado, will, according to reports, build a dam several feet higher than the Cheesman dam, and therefore the highest in the world. The site is a gorge at Terrace, on the Alamosa River, fifteen miles below La Jara. The first hundred feet of the dam will close a 25-ft. opening between walls of solid rock. The rock walls then separate, widening to 250 ft. This opening will be closed by the next hundred feet of dam, which will extend ten or more feet above the summit, a total height of 210 ft. The dam will be a quarter of a mile long. The reservoir thus formed will cover a tract 200 ft. wide by three and a half miles long and 200 ft. deep.

Fundamental Principles of Power Equipment for Telephone Exchanges.

BY B. D. WILLIS.

CONTINUOUS and uninterrupted service of a central energy telephone system demands that the supply of primary power be constant and sure, and, as a means of insuring such service, it is imperative that there be two or more sources of primary power and at least two sets of equipment for transforming the primary energy into the proper form for the operation of the system; also a safe means for storing up this energy in sufficient quantity to tide over a temporary failure of all sources of primary power available.

The fundamental parts of telephone power plants are: (1st) The storage battery, from which current is furnished directly to the lines, relay racks and switchboard for talking, and the operation of signals. (2d) A means of charging the storage batteries by transforming the energy of the primary power into charging current of the proper voltage. (3d) Apparatus for generating, ringing and other audible signaling currents. (4th) Equipment for the control and switching of all the various forms of electrical energy; and, (5th) The conduit and conductor system for the transference of the energy.

THE STORAGE BATTERY.

Duplicate storage batteries should be installed in all cases; the number of cells in each battery depending on the voltage upon which the system is designed to operate. There are two standard voltages in use at the present time: the 20-volt systems, as adhered to by the American Bell Companies and certain independent manufacturers, and the 40-volt system, used by the Stromberg-Carlson Telephone Manufacturing Company and others.

Of these two standards, the 40-volt system presents certain advantages, owing to the fact that to convey equivalent amounts of energy but half the current is required at 40 volts as at 20. The advantage on long lines is obvious. On lines of any length the current strength being halved, induction and cross talk are correspondingly diminished, while by winding repeating or induction coils to a higher resistance the required amount of induction may be obtained where it is a desirable quality. Another point in favor of the higher voltage is that transmitters may be made higher in resistance, thus increasing the percentage of the varying talking resistance to the total resistance of the line, and upon this percentage good transmission largely depends.

The size of the individual cells depends upon a number of conditions, and it must be borne in mind that in figuring out a battery it is not sufficient to provide for present needs, but the probable growth must be taken into account and provisions made to take care of such growth. It is customary, therefore, to provide lead-lined tanks or glass jars of sufficient capacity to contain the elements required to operate the ultimate capacity of the switchboard and to equip those tanks with elements of sufficient storage capacity to carry the load imposed by the present equipment.

The conditions determining the size of the cells are as follows: First, what will the load or discharge rate be? This depends not only upon the size of the exchange, but upon the business and social activity of the city wherein the plant is located; upon the outside line construction and upon the electrical design of the system. Experience is the only key to this problem and we may assume that from .1 to .25 amp. may be allowed for each connection put up, according to the system; that from ten to fifteen connections per day of 24 hours are allowed for each subscriber, and that each connection lasts an average of three minutes.

The second condition relates to the number of hours which the battery must be capable of carrying the load upon a single charge. This depends in turn upon the number of hours of the twenty-four during which charging current is available, for it is often the case, especially in smaller cities, that light and power companies offer certain reductions to consumers using current during light-load hours, while in some localities no day current is supplied. Local conditions are, therefore, an important factor. The minimum permissible battery capacity is that which would be obtained by allowing for an eight-hour charge at the normal rate of the battery out of each twenty-four hours.

It is perhaps wiser though, especially in the smaller exchanges, to figure the battery to carry the load for 36 hours, or even 48 hours,

upon a single charge. Then, by using the batteries alternately, charging one while the other is discharging, we are able to work the batteries up near the point of greatest efficiency; that is, between three-fourths charge and full charge, as the lower and upper limits respectively, and at the same time insure continuous operation.

The efficiency of storage batteries averages between 75 and 80 per cent. in telephone work.

CHARGING EQUIPMENT.

There are two methods in common use for charging storage batteries: First, charging directly from electric light or power mains through an adjustable resistance in series with the battery. Second, charging by means of a special generator, which may be direct-connected to a motor, operating upon commercial circuits or driven by a gas engine, water turbine or a convenient shaft.

The first method is not at all economical, as commercial electrical circuits are very seldom of a lower voltage than 110, and to reduce the potential at the battery terminals to 45 volts or 25, necessitates using a dead resistance in series, which dissipates a large percentage of the energy, and is seldom used except for very small cells. The second method, involving the use of a special generator, is in almost universal use, as it is more economical, more flexible and more satisfactory in all respects when properly installed.

Of the different methods of driving the generator, the direct-connected motor is the most common and probably the most satisfactory. There are several firms manufacturing special telephone motor-generators at present, in which the motor and generator are twin sets, mounted upon a common sub-base and directly connected by means of a flexible insulating coupling keyed to the shaft. The machines are also insulated from the sub-base, thus preventing any electrical connection between them.

As it is frequently desirable, and even necessary, to charge a battery while it is supplying current to the switchboard, and as the telephone receiver is such a marvelously sensitive instrument, the necessity of smooth commutation is evident. The commutator must be composed of a large number of long, narrow segments, 90 or more; the brushes must hug it closely and have no perceptible vibration. The armature and field must be liberally proportioned. The bearings of the machines should be supported on pedestals as in the common engine type generator and not on the crown pieces, thus leaving the space about the commutator open and easily gotten at for inspection and cleaning.

The writer is not informed as to what has been done by other companies, but has found it possible with proper precautions to operate the Stromberg-Carlson system directly from the generator without the intervention of storage batteries and without the slightest disturbance on the lines. While it would not be at all advisable to attempt to get along without a storage battery, it is a comfort to know that in case of a disaster to the battery the exchange could still operate until the necessary repairs were made.

The electrical efficiency of motor-generators, that is, the percentage of watt output to watt input, varies from 46 to about 73 per cent., according to the size and construction of the machines.

The size of the motor-generator must be such that the generator shall have sufficient output to charge the storage battery of the ultimate capacity within the time limit, if there be one. Eight hours is generally taken. Charging sets should always be installed in duplicate and the motors wound for separate primary circuits leading in from different central stations where possible, otherwise it is well to install a gas engine or turbine and an engine type generator. Spare armatures are advisable.

RINGING MACHINES.

There are three types of ringing machines to be considered. The motor-generator, the dynamotor and the belt-driven generator, all of which answer the same purpose; that is, the generation of alternating and other signaling currents for actuating the telephone bells at the subscribers' sub-stations. The only essential difference in the types is in the application of the driving power. The frequency of the machine must be that best suited to the natural vibration frequency of the vibrating member of the ringers used on the telephone instrument, the most common frequency being in the neighborhood of 20 cycles per second, corresponding to from 2,200 to 2,400 alternations per minute.

Where selective ringing is required in addition provision must be made for the same on the ringing machines. The two most popular schemes for selective ringing are: First, the application of positive and negative pulsating currents to either side of the line, in connection with biased ringers, connected between one side of the line and ground, which ringers respond only to current in one direction, giving four parties; and second, the employment of widely different frequencies in connection with telephone ringers having either tuned or weighted hammers, which respond only to frequencies within certain limits; or an arrangement of induction coils and condensers to choke or shunt the current, as in the Leich system. The practical limit of this system is also four parties.

In addition to the regular signaling currents mentioned above, it is usual to provide attachments known as the "busy back" and "howler." The former furnishes current for giving the well-known busy signal, and consists of a toothed wheel, the spaces between the flat-topped teeth being filled with fibre, as a means for rapidly interrupting battery current at intervals, which when heard in the receivers resembles the buzz of a large insect repeated at regular intervals and signifies that the line desired is busy. The "howler" is a similar device, but interrupts the flow of current at a much higher rate and continuously, and is used when a subscriber neglects to hang up his receiver when leaving the instrument. When applied to a line it causes the receiver to emit a sort of a whistling howl, which very soon attracts attention and on account of its weird, disagreeable note accomplishes the desired purpose. When the receiver is off the hook the ringer is shunted by a lower resistance and consequently cannot be rung until the receiver is replaced. Ringing machines must always be installed in duplicate and one should run as a motor on battery current.

THE POWER BOARD.

The power board is usually constructed of a number of marble or oiled slate slabs, mounted upon angle-iron frames, which are securely fastened to the floor and braced by bar iron pieces from the wall in the rear. The slabs are cut to a convenient size, ordinarily 6 ft. x 3 ft. x 1¼ in., or thereabouts, and carry the proper equipment for rapid and convenient handling of all power circuits. For large exchanges four panels arranged as follows will be found practicable.

Panel No. 1, or starting panel, carries the motor switches and enclosed fuses for the primary power circuits, the starting boxes or compensators, an ammeter and a two-way ammeter switch. Panel No. 2, or the battery panel, carries the adjustable field rheostats for the generators, an underload and overload circuit-breaker connected in the charging circuit, a voltmeter and six-point switch and generally four double-pole, double-throw knife switches, for throwing either battery on the charge or discharge circuit, for throwing either generator into service, or for floating either or both batteries on the system; and in cases of emergency for throwing the generator directly on the discharge with both batteries cut out.

Panel No. 3 carries the various knife switches for manipulating the signaling circuits, fuse bars for fusing the various signaling current leads to the switchboard positions and lamp resistances for the same, if such be used; and a low-reading voltmeter with two multiple-contact switches for voltage readings on the individual cells of the two storage batteries. Panel No. 4 carries the various battery fusing and terminal bars for the power leads to the switchboard and relay bays, and an ammeter with a multiple switch for reading the discharge on the various circuits. In addition to the above, each panel has mounted in the upper center a single lamp bracket with incandescent lamp and half shade for illumination.

THE CONDUIT SYSTEM.

All power wires and cables between the power board and machines and the batteries should, where feasible, be run in iron-armored conduit. The conduits should be brought up against the wall in the rear of the power board to a height of at least 6 ft. above the floor, where they are bent over toward the board, so as to line up nicely, thus bringing all leads in at the top of the switchboard, whence they are taken down to the proper terminals. This arrangement leaves the space back of the board clear and open, allows plenty of head room and presents a clean and finished appearance.

From the wall in the rear of the board the conduits are laid in or under the floor to the machine pier and battery terminals. This machine pier should be built hollow. It may be constructed either as a rectangular brick well, covered on top with slate or marble slabs, or with a heavy iron framework, completely covered with marble slabs bolted to the iron.

With a hollow pier the conduits may be brought straight out

from the powerboard without making any awkward crossings, the conduits all having outlets in the well, where the conductors may be crossed in flexible duct over to the proper positions for connecting to the machine terminals. Means should always be provided for getting into the pier, so that any change in wiring may be easily made.

A very neat and highly finished appearance is imparted to the work by carrying the conductors up through the slabs in polished brass or copper risers, so bent as to deliver the conductors within a few inches of the terminals.

Where metallic conduit is used all wires of any alternating-current circuit should be drawn in the same conduit to prevent excessive heating of the metal by induction.

Special Methods for Locating Faults on Electric Cables.

By Henry W. Fisher.

COST of the special methods given in this article were worked out by the writer on different occasions where the conditions were such that the ordinary methods in their simplest form could not readily be applied. As these special methods are more or less connected with the Murray & Varley "Loop Tests," to which frequent reference will have to be made, it will first be necessary to give diagrams and a brief description of said loop tests.

MURRAY LOOP TESTS.

This is the simplest method of locating grounded or crossed wires in cables. It is illustrated in Fig. 1 with this exception, that the conductor, C', is not usually connected at the far end of the cable. Fig. 1 is used in connection with Fig. 2 in a special method which will next be given, and this accounts for the reason why C' is connected in the diagram. In applying the Murray loop the good conductor and the bad conductor must be of the same size. In making this test it is only necessary to adjust the resistance, R, until the galvanometer is not deflected, when the distance to the fault equals

$$\frac{A \times L}{A + R}, \qquad (1)$$

where A and R represent the resistances, as shown in the diagram, and L represents the combined length of the good and bad wire.

It frequently happens in practice that a good wire of the same size as the faulty wire is not available for a test, and it is under such conditions that the special method which the writer devised and has applied for some years back, is of use.

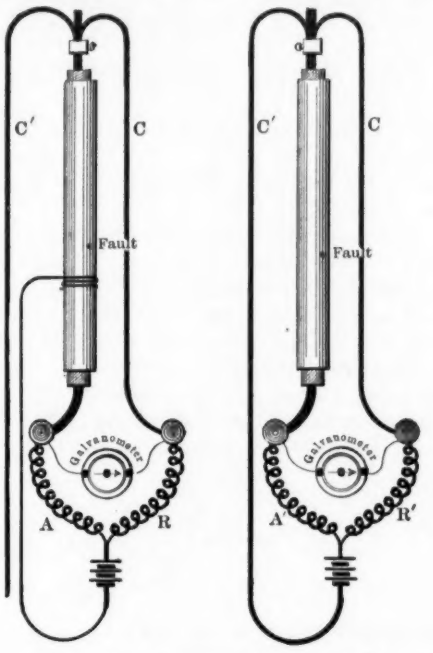
To apply this method it is only necessary to have two good wires whose respective ends can be connected to the ends of the faulty wire. The three wires are first connected at the far end of the cable and then the connections, as shown in Fig. 1, are made and A and R are adjusted until the galvanometer is not deflected when the values of A and R are recorded. The wire running from the battery to the lead cover of the cable is then removed and connected to the conductor, C', as is shown in diagram 2, after which the resistances, A' and R', are adjusted until the galvanometer is not deflected and the values of A' and R' are duly recorded. Letting L equal the length of the faulty conductor, the distance to the fault is:

$$\frac{A \times L \times (A' + R')}{A' \times (A + R)}. \qquad (2)$$

In the application of this method the resistances of C' and C may be quite different without affecting the result; hence, before the test is applied, sufficient wire can be connected to C at either end for the connections, as shown in the diagram. Under the conditions above given, the distance to the fault can be located by the Varley loop method, but in order to do so it is necessary to make four measurements, three of which are needed to determine the resistance of the faulty wire and one to find the resistance to the fault by the regular Varley loop test. Therefore, by the application of the method given above, much time can be saved and the fault can be located very accurately. Usually the same values for A and A' can be used and the calculation is then simple. If the faulty wire cannot conveniently be connected to the Wheatstone bridge a wire of the same size should be used to make the connection, when it will be necessary to add the length of said wire to the length of the cable in place of L in the formula, and then subtract the length of the wire from the calculated distance to the fault.

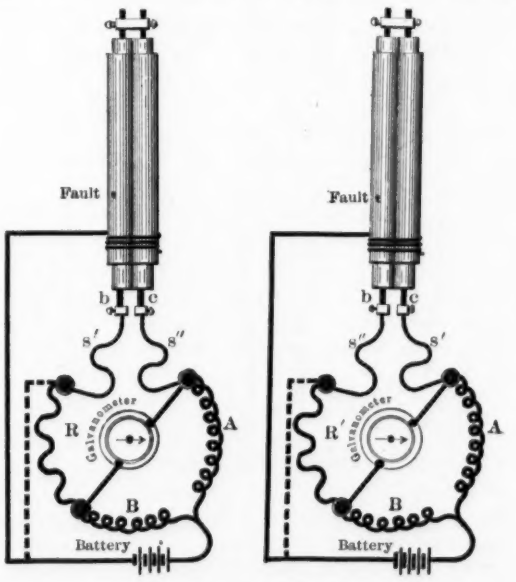
VARLEY LOOP METHOD.

Fig. 3 shows the connections for the Varley loop method of locating a ground in a wire. The combined resistance of the good and bad conductor and the leading wires connecting them to the Wheatstone bridge, is first measured by the Wheatstone bridge. For this test the battery must not be connected to ground, but the connection



FIGS. 1 AND 2.—MURRAY LOOP TESTS.

must be made which is shown by the dotted line in the diagram. The resistance of the leading wire, S', which runs to the faulty conductor, must next be determined; then the battery is connected to ground as shown by the full line in Fig. 3, after which the resistance, R, in the Wheatstone bridge is adjusted until the galvanometer is not deflected, when the values of A, B and R are recorded. Letting



FIGS. 3 AND 4.—VARLEY LOOP TEST.

r equal the combined resistance of the leads and the good and bad wires, the distance to the fault

$$= \frac{B \times r - A \times R}{A + B} - S'. \qquad (3)$$

It is next necessary to determine the resistance of the faulty wire. If the good and bad wire are of the same size and length, the resistance of the faulty wire, which we will call b, is practically equal to one-half the combined resistance of the good and bad wire. If the good and bad wire are not of the same length, a third good wire is generally employed and three resistance measurements involving the different combinations of the one bad and two good

wires, are made when the exact resistance of the faulty wire can be calculated by well-known formulæ which need not be mentioned here.

It frequently happens, however, in practice, that only one good wire is available for a test, and that there may be several bad wires of the same size and length. In order to locate a fault under these conditions, the writer devised a method which is illustrated in Fig. 5, and to apply which it is necessary to make the following resistance measurements:

First, measure the resistance of the good wire in series with one bad wire.

Second, measure the resistance of the good wire in series with the other bad wire.

Third, measure the resistance of the good wire in series with the two bad wires in multiple.

Let b and b' represent the respective resistances of the bad wires. Let c represent the resistance of the good wire. Let r, m and n represent respectively the resistances above referred to. Fig. 5 shows the three sets of connections and under each respectively are the letters r, m and n, representing the respective resistances. The resistance of the leading wires, S' and S'', does not enter into the calculation, and hence need not be considered. The same leading wires, however, must be used throughout the series of tests.

The values of b and b' can now be calculated by the following formulas:

$$b = r - n + \sqrt[2]{n\,(n - [r + m]) + r\,m} \qquad (4)$$

$$b' = m - n + \sqrt[2]{n\,(n - [r + m]) + r\,m} \qquad (5)$$

Where resistances r and n do not differ by more than 2 or 3 per cent., the following approximate and much simpler formula may be employed:

$$b = \frac{3r + m}{2} - 2n, \qquad (6)$$

$$b' = \frac{3m + r}{2} - 2n. \qquad (7)$$

This method is very satisfactory and can often be applied to

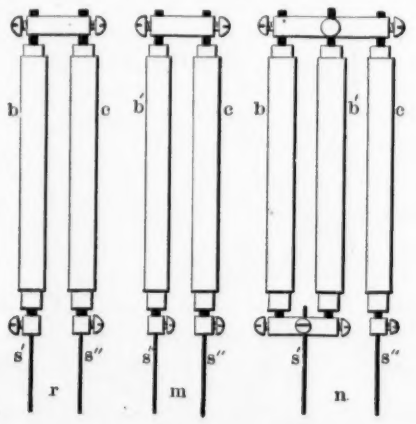


FIG. 5.—DIAGRAM OF CONNECTIONS.

bad and then if a good wire through some outside source is available for a test, the resistance of the faulty wire can be easily determined by this method, after which the resistance to the fault can be found by the Varley loop method, when the distance to the fault is obadvantage in practice. Frequently all the wires of a cable become tained by dividing the latter by the former, and multiplying by the length of the faulty wires.

This method cannot be applied with absolute certainty when the faults on the bad wires, b and b', occur at different points. The Varley loop test will determine whether this is the case or not. If the resistances of the faults are high and the resistances of the faulty wires are comparatively low, the resistance of the faulty wire may still be determined quite accurately even though the faults be considerable distance apart. When a number of wires fail in a cable at the same time, it can generally be assumed that the location of the faults is at the same point. If the trouble has been caused by lightning this may not, however, be true.

It frequently happens that leading wires of considerable length may have to be used to connect a faulty cable with the Wheatstone bridge, and it also sometimes happens that the resistance of each leading wire may be different and that it may be inconvenient or impossible to measure the resistance of the leading wire, S', which runs from the Wheatstone bridge to the faulty conductor of the cable.

Working under such conditions, the writer devised the following method for determining the resistance of the leading wire, S'. The connections shown in Fig. 3 are first made, after which the values of A, B and R are determined in the manner which has been explained above under the Varley loop test. Then the leading wire, S' and S'', are completely reversed, as is shown in diagram 4. Using the same values of A and B, the resistance, R', is adjusted until the galvanometer is not deflected and then its value is recorded. The combined resistance of S' and S'' is next measured, when the resistance of S' can be calculated by the formula:

$$S' = \frac{S' + S''}{2} + \frac{A \times (R' - R)}{2\,(A + B)}. \qquad (8)$$

The first test gives the values of A, B and R and from the formula just given, the value of S' can be calculated. It is only necessary to determine the combined resistance of the leads and the good and bad wire, when the resistance to the fault can be calculated by formula (3).

Now, if there happens to be a second bad wire of the same size and length as the one under consideration, the resistance of the bad wires can be readily determined by formulas (4), (5) or (6), (7).

If there is no such bad wire, and if there is one other good wire, the resistance of the faulty wire can be determined by making resistance measurements of the three possible combinations of the good and bad wires, as has previously been mentioned. It is possible, however, to get the resistance of the faulty wire by making two measurements instead of three. To do this first measure the resistance of the bad wire, b, and the good wire, c. Second, make the connections for the Varley loop, substituting the good wire, c, for the bad wire, b, in Fig. 3, and the second good wire, c', for c, in Fig. 3. Then ground the connection of the two good wires at the distant end of the cable, when the regular Varley loop test can be applied, and the values substituted in formula (3) will give the resistance of the good conductor, c, which subtracted from the combined resistance of b and c first measured, will give the resistance of the faulty wire.

Deficient Facilities for Stock Reporting.

Quite recently all the markets were paralyzed as to news and trading by the interruption and destruction of telegraph and telephone circuits by the great storm. Complaints are now frequent that when the markets are as active as they have been during the past week, the facilities within the New York Stock Exchange are not equal to the burden thrown upon them. The New York *Times* discusses this question seriously, and remarks: "One of the features of the collapse in the market last week was the demonstration of the insufficiency of the stock market apparatus to meet the demands of a three-million-share day. Wall Street heard with astonishment that London connections were better served and in closer touch with our market here than were the customers in brokers' offices not more than a block away from the floor of the Exchange. The business between the curb in London where American stocks are dealt in and the Stock Exchange in this city is carried on by arbitrageurs who pay to the Stock Exchange enormous sums every year for the privilege of sitting on a stool behind the rail on the very floor of the Exchange so that they can keep in actual touch with the market by employing floor brokers to do business for them. These arbitrageurs in turn have direct cable communication with the London curb, and orders to buy or sell can be executed in either market as quickly as they can ordinarily be executed for customers in brokers' offices here.

"On Thursday, however, the Londoners had all the advantage The telephone system between the floor and the offices of brokers in this city became badly clogged. There were not enough wires to carry all the messages, orders, reports, etc., and as a result orders were generally carried out at prices considerably at variance from those which the customer expected. Then, too, the ticker was so far behind that customers in the offices had no idea what the market was at the time they gave in their orders.

On the Theory of the Regulation of Alternators.

BY C. F. GUILBERT.

MESSRS. Hobart and Punga have presented under this title, before the American Institute of Electrical Engineers,[1] a paper of peculiar interest which gives in simple form the demonstration of a method of calculation of the load characteristics of an alternator.

These authors set forth some observations identical with some which I made in this journal two years ago[2] in a similar study, which they show in a highly ingenious fashion, by making the demonstration very simple and by presenting the consideration of the center of gravity of the surface as representing the distribution of the m.m.f. along the polar surface.

I do not wish to repeat here the absolutely legitimate objections presented by M. Karapetoff.[3] Moreover, I have recently[4] published a method of calculating the equivalent ampere-turns of any winding whatever of an alternating-current dynamo, which is much more simple than the first, and which, moreover, leads to results identical with those obtained by the preceding. I will only recall to your attention what I had pointed out in my first paper—that it was impossible to admit with Prof. Arnold and as Messrs. Hobart and Punga have implicitly assumed, that the width of the field magnet flux at its entrance into the armature is equal to that of the polar surface.

The actual width is in reality almost always equal to the pole pitch, except for those pole pieces whose width does not exceed from 0.5 to 0.6 of the pitch.

The compilation of experimental results furnished by Messrs. Hobart and Punga shows that if these results are sufficiently in accord with the provisions of the calculation for the curve on short-circuit and the characteristic on partially inductive load, there is a somewhat marked divergence as soon as the attempt is made to predetermine the characteristic on completely inductive load.

My intention now is to show that the method suggested by me two years ago leads in general, and more especially in the case of an inductive load, to a much greater approximation than that of Messrs. Hobart and Punga, the case given by them serving me as an example.

This new study will permit me to point out a generalization of a diagram made previously in the case of an alternator armature well below saturation, in order that its real characteristic, or real curve of load, may be considered a straight line.[5] We will take up successively the three cases treated by these authors: the characteristic on short-circuit, the characteristic on non-inductive load, and the characteristic on completely inductive load.

CHARACTERISTIC ON SHORT-CIRCUIT.

I have indicated as the value of the equivalent m.m.f. per pole of a three-phase winding of the kind employed in the alternator of the Central London Railway, i.e., with two slots per pole and per phase, the formula:

$$f_i = 0.588\, N I \sqrt{2},$$

f_i being the equivalent m.m.f. in ampere-turns per pole; N the number of conductors per pole and per phase; I the effective strength of the current in amperes per phase; Ψ the dephasing between the e.m.f. on open circuit and the current on load.

If this formula is applied to the case of the alternator in question and for a dephasing of a quarter period, we get

$$N = 28, \quad I = 98.5, \quad \Psi = 90°.$$

The result is

$$f_i = 0.588 \times 28 \times 98.5 \times 1.414 = 2{,}300 \textit{ ampere-turns.}$$

Messrs. Hobart and Punga take for their calculation the formula:[6]

$$f_i = 0.77\, \beta\, q\, N I,$$

β being the factor of width and q the number of phases.

This formula gives here

$$f_i = 0.77 \times 0.96 \times 3 \times 28 \times 98.5 = 3{,}050 \textit{ ampere-turns.}$$

The difference is, therefore, considerable. The figures obtained by Messrs. Hobart and Punga seemed, moreover, less than the real value obtained experimentally on short-circuit. I have never attached a great importance to the predetermination of the characteristic on short-circuit, which has no practical interest. I have besides every reason to believe that the value of f_i given in my formula, which presupposes the current sinusoidal, is not rigorous on short-circuit with alternators which do not give an approximately sinusoidal e.m.f. This is the reason why in the verification of my formula on the alternators at the Paris Exposition, I have considered as of particular value the results obtained on alternators devoid of harmonics, or connected in delta—which, as is known, have shown a marked agreement. On the other hand, the formula supposes that the Foucault currents in the pole pieces are negligible. With alternators having damping plates, especially, the results obtained from the above-mentioned formula have always been less

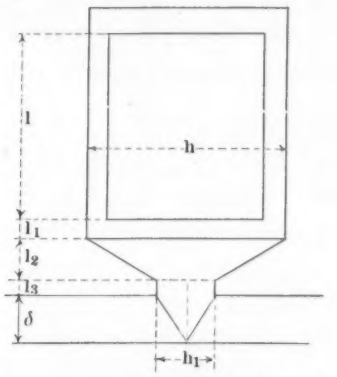


FIG. I.—SLOT DIAGRAM.

than those obtained experimentally, but for reasons which I have not yet been able to explain, although I have found a sufficiently exact formula for particular cases.

However, it may be that the value of f_i found above will lead to figures obtained on load very like those found experimentally. The influence of the armature m.m.f. is, moreover, as we shall see further on, much less than those of the e.m.f. of dispersion.

The value of the e.m.f. of dispersion of the armature calculated by Messrs. Hobart and Punga seems to me too high.

In general, I determine the value of the e.m.f., e_1 and e_2, corresponding to the outer portions of the coil (free length) and to the inner part of the slots (embedded length) with the aid of the following formulas, due to Prof. Arnold, and slightly modified to make their application easier and to include in the second the stray fluxes in the entrefer:

$$e_1 = 0.4\, \pi\, f\, I N^2\, \frac{p}{p'}\, \lambda \left(log_e \frac{\pi\, \lambda^2}{4\, ab} - 2 \right) 10^{-8}$$

$$e_2 = 8 f\, k\, I N^2\, \frac{p}{p'^2}\, \frac{L}{u} \left(\frac{l_3 + \delta}{h_1} + \frac{2\, l_2}{h_1 + h_2} + \frac{h_1}{h} + \frac{l}{3h} \right) 10^{-8}$$

In these formulas the new notations are:

f the frequency, in periods per second; p' the number of parallel circuits per phase; λ the length of the outer part of each conductor; a and b the dimensions of the bundle of wire formed by a coil; u the number of slots per pole and per phase; k the coefficient of value $\dfrac{\sin \frac{\pi}{2q}}{u \sin \frac{\pi}{2qu}}$ for the kind of winding considered; δ the entrefer; l, l_1, l_2, l_3, h and h_1 the dimensions of the slots represented in Fig. 1.

The first of these formulas takes no account of the influence of

[1] *Transactions*, A. I. E. E., page 183, vol. xxi.
[2] *Electrical World and Engineer*, vols. 40 and 41, Oct., 1902, and Jan., 1903.
[3] *Transactions*, A. I. E. E., page 589, vol. xxi.
[4] *Electrical World and Engineer*, vol. 43, page 516, March, 1904.
[5] This diagram, outlined in my lectures on the calculation of alternators given to the students of the École pratique d'Électricité industrielle of Paris, has been published in a general study of the diagrams of alternators, in the *Revue Technique* (April 25 and May 25, 1904).

[6] It is to be observed that this formula does not differ from that which we have given in the same case except in the value of the factor of width

$$F_i = q \frac{4}{\pi^2} \sin \frac{b}{a} \frac{\pi}{2} \sin \frac{b^1}{a} \frac{\pi}{2} NI\sqrt{2}$$

when b is replaced in it by the width of the polar piece. This gives then in fact:

$$F_i = 0.77 \times q \sin \frac{b^1}{a} \frac{\pi}{2} NI.$$

the different coils of the same phase among themselves, nor of the mutual induction of the phases among themselves; it corresponds, besides, to a single coil (formed by several elementary concentric coils) per pole.

The presence of masses of iron augments the coefficient of self-induction by about 20 per cent., while the mutual induction of phases among themselves, by about as much more, for an ordinary alternator winding, so that one may retain the value of e_1 given in the preceding formula, if there is only one coil per pole in the winding, and double the results when the coil is but one to a pair of poles, as in the case of the alternator now under consideration. We have here:

$$f = 25;\ p = 1;\ \lambda = \frac{106}{2} = 53;\ a = 7.6 \text{ cm.};\ b = 3.3.$$

The first formula gives, by multiplying the results by 2,

$$e_1 = 2 \times 0.4 \times \pi \times 25 \times 98.5 \times 28^2 \times 16 \times 53 \left(\log_e \frac{\pi \times 53^2}{4 \times 3.3 \times 7.6} - 2 \right) 10^{-8} = 100 \text{ volts},$$

a figure perhaps too large. Messrs. Hobart and Punga found, however, 142 volts.

The second formula gives us, when $k = 0.965$; $u = 2$; $L = 27.5$ cm.; $l_3 = 1.2$ cm.; $\delta = 0.8$ cm.; $l_2 = l_1 = 0$; $l = 7.6$; $h = h_1 = 3.3$ cm.

$$e_2 = 8 \times 25 \times 0.965 \times 98.5 \times 28^2 \times 16 \times \frac{27}{2} \left\{ \frac{1.2 + 0.8}{3.3} + \frac{7.6}{3 \times 3.3} \right\} \times 10^{-8} = 45 \text{ volts},$$

a value less than half of that found by Messrs. Hobart nd Punga.

The e.m.f. of dispersion is then, to sum up:

$$100 + 45 = 145 \text{ volts}.$$

Add 5 per cent. of the e.m.f. per phase—an estimate that seems to us just for an alternator of low frequency and with slots entirely open.

We will, moreover, note that we have already outlined a simple method of estimating the e.m.f. of dispersion with the aid of a test coil wound turn by turn with one of the armature coils, and placed

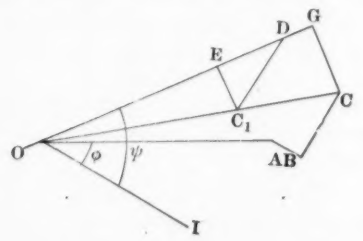


FIG. 2.—DIAGRAM OF OPERATION.

in series with another coil of the same number of turns wound in the opposite direction, placed in the same slots as near as possible to the entrefer and having the same shape as the armature coil.[7]

The values of the equivalent m.m.f. and of the e.m.f. of dispersion, thus determined by calculation, will serve for the determination of load characteristics both on non-inductive resistance and on inductive resistance.

In this connection I may again refer to the diagram which I had suggested, as well as to its generalized application.

DIAGRAM OF OPERATION.

Fig. 2 represents this diagram. $O I$ is the direction of the current, $O A$ the pressure at the terminals, $A B$ the ohmic drop, $B C$ the e.m.f. of dispersion, and the resultant $O C$ the e.m.f. actually induced in the alternator.

If one draws to a suitable scale $O C_1$, the number of ampere-turns necessary for the entrefer, and the armature to produce the e.m.f., $O C$ obtained in the armature, then $C_1 D$, parallel to $B C$, a vector equal to the m.m.f. (for $\Psi = 0$), the vector sum, $O D$, gives the m.m.f. necessary for the passage of the flux under load in the entrefer and armature, to counterbalance the m.m.f. directly induced (demagnetizing ampere-turns). The perpendicular, $C_1 E$, is then drawn to $O D$, the vectors, $E D$ and $E C_2$, representing respectively the direct m.m.f. (demagnetizing ampere-turns) and the transverse m.m.f. (distorting ampere-turns)—because the angle Ψ is the angle of current dephasing with respect to the e.m.f. at open circuit. $O E$ is the m.m.f. necessary for the passage of the useful flux which actually emanates from the armature and which combines with the flux of distortion to give the total working flux.

The working flux actually emanating from the field pole would

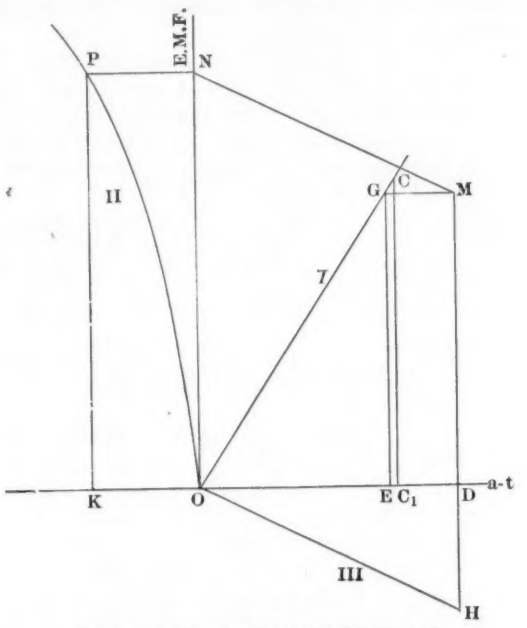


FIG. 3.—ARMATURE CHARACTERISTICS.

correspond to an e.m.f. represented by the projection, $O G$ of $O C$ on $O E$.

In order to have the total m.m.f. to be placed upon the field magnet, it will suffice to find, with the aid of the characteristic of stray magnetism of the inductor, the value of the stray flux of the field magnet, corresponding to the difference of magnetic potential between the polar projections, $O E$; then to add *arithmetically* this flux to the useful flux actually emanating from the entrefer, and, finally, to determine the number of ampere-turns necessary to make this combined flux pass through the field magnet.

This operation is easily effected with the aid of the simple construction represented by Fig. 3. The curves I, II and III are the partial characteristics of the armature (including the entrefer), of the field magnet, and of the circuit of dispersion of the field magnet; that is to say, the curves of the flux passing through the different parts and the corresponding ampere-turns.

Having obtained from $O C$ the m.m.f. (on curve II supposed to be a straight line) necessary to obtain the e.m.f. $O C$ of Fig. 2, this latter figure is the result, and $O E$ and $O D$ (Fig. 3) represent the values of the m.m.f. $O E$ and $O D$ (Fig. 2). $O E$ corresponds to the working flux, $F G$, actually emanating from the field magnet. The stray flux of the field magnet being $D H$, the combined flux flowing from the field magnet is:

$$E G + D H = M D + D H = M H.$$

Drawing from M, then, a parallel to the straight line, III, as far as N, then through N parallel to the axis of the ampere-turns, there is obtained in $P N + O D$ or $K D$ the total m.m.f. sought.

The preceding diagram, applicable as we have said, only in the case of the characteristic of the armature being a straight line, can be generalized for the case where the armature is itself saturated. In this case it is necessary only to substitute for the characteristic of the armature that of the entrefer, to determine the flux actually issuing from the field magnet. Or, in other words, one must carry to $O C_1$ (Fig. 2) the ampere-turns necessary to produce in the entrefer the flux corresponding to the e.m.f., $O C$; then, having completed the construction of the triangle of the magneto-motive forces, $O C_1 D$, on the open-circuit characteristic of the armature

[7] It is easy to prove by calculation that the combination of the two coils will readily give the e.m.f. of dispersion of the coil considered. The calculation which we are reserving to publish in a later paper shows equally well that we can often replace a coil turn by turn by another suitably selected for position and number of windings.

(Fig. 4), will be drawn the value of the m.m.f. OE necessary to cause the working flux actually issuing from the field magnet to pass into the entrefer—and which consequently will be EG. To obtain the ampere-turns necessary for the armature alone, a line, GM, is drawn, parallel to OE, until it meets the complete characteristic of the armature (or, better still, that obtained after study of the distortion for a given output and different working fluxes); GM

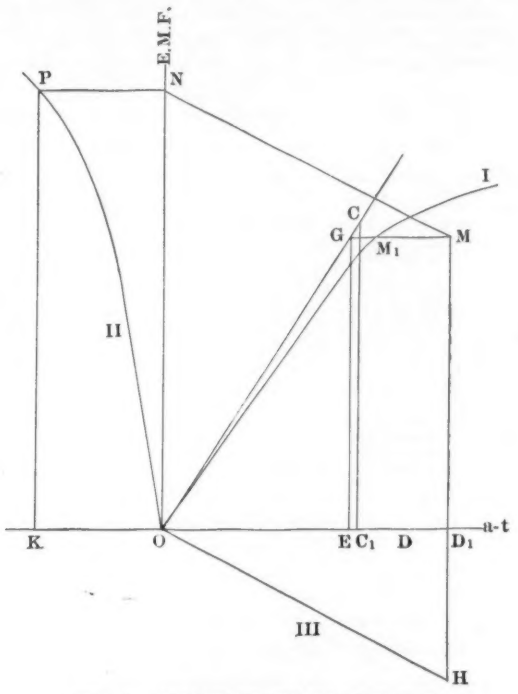


FIG. 4.—ARMATURE CHARACTERISTICS.

will represent the desired complement of the ampere-turns. It will then suffice to prolong GM, by an amount MM_1 equal to $f_1 \sin \Psi$ (ED of Fig. 2), and to complete the construction as in the preceding case, KD_1 being the total excitation at the desired load.

Remark.—Since, as in that of the alternator studied by Messrs. Hobart and Punga, the characteristic of the field magnet alone is deduced from the difference between the characteristic C^i on open circuit, obtained experimentally, and the characteristic C^i calculated for the armature, it is not necessary to enlarge upon this difference in the relation of the coefficient of Hopkinson on open circuit, which is also variable[8], to obtain the characteristic of the flux in the field magnet. In fact, this difference may be maintained and it may be remarked that this characteristic takes into consideration the stray flux of the field magnet for the ampere-turns necessary to the armature, and corresponding to the operation on open circuit with the same flux as on load. It is necessary, then, to add to the working flux only the complementary stray flux of emanation corresponding to the direct m.m.f. which is obtained by arresting the parallel to the line III drawn through the point M_1 to the vertical above the point M_1, corresponding to the same working flux on open circuit, and to draw through the point T the parallel to OE to have between NP or OK the ampere-turns necessary to the field magnet and at KD_1 the total ampere-turns on load.

Messrs. Hobart and Punga having given, in their paper, the partial characteristics of the field magnet and the entrefer, that of the armature can be deduced from them. On the other hand, we admit the coefficient of Hopkinson, calculated by them for a low induction, which has enabled us to construct the straight line of the stray fluxes of the field magnet. We have thus drawn the curves on Fig. 6. We have here all the necessary conditions for the predetermination of the load characteristics.

CHARACTERISTICS ON NON-INDUCTIVE LOAD.

In order to avoid an inordinate length for this paper, we will content ourselves with the calculation of a point of the curve near to full load. The point observed nearest to the full load is the following:

E.m.f. per phase = 3,000 volts.
Strength of the current = 102 amperes.
Total ampere-turns = 9,100.

[8]See *L'Eclairage Electrique*, vol. xxxvii, p. 481, Dec., 1903.

The diagram of voltages gives (Fig. 7) with $OA = 3{,}000$; $AB = 32.5 \times \frac{102}{98.5} = 34$ volts; $BC = 145 \times \frac{102}{98.5} = 150$ volts.

A value of $OC = 3{,}040$ volts.

The characteristic of the armature gives for this voltage a m.m.f. of 5,850 ampere-turns; the result, then: $OC_1 = 5{,}850$.

If one makes

$$C_1D = 2{,}300 \times \frac{102}{98.5} = 2{,}380 \textit{ ampere-turns},$$

there is obtained as a result: $OE = 5{,}500$ and $ED = 950$.

The 5,500 ampere-turns correspond to a pressure of 2,870 volts and the total m.m.f. for the armature alone is 6,700 ampere-turns. The construction given above gives for the conductor 2,250 ampere-turns; the total excitation is then

$$6{,}700 + 2{,}250 = 8{,}950 \textit{ ampere-turns},$$

a figure sufficiently near to that obtained experimentally. For the normal output at the same pressure would be found:

$$6{,}600 + 2{,}000 = 8{,}600 \textit{ ampere-turns}.$$

The values found by Messrs. Hobart and Punga differ but little from the foregoing, and, moreover, it will be always the same for this reason: that the e.m.f. of dispersion, and the m.m.f., being drawn perpendicularly to the normal pressure, their influence is less than in the case we are now going to study.

CHARACTERISTICS OF INDUCTIVE LOAD.

Let us take the case of a power factor equal to zero. Messrs. Hobart and Punga give the following observations:

Voltage per phase = 2,880 volts.
Strength of current = 102 amperes.
Power factor = 0.15 to 0.25.
Total excitation = 12,000 ampere-turns.

The application of the diagram is here much simpler, because the ohmic drop can be disregarded, in such manner that the diagram is reduced to a straight line.

The pressure actually induced in the machine is here:

$$2{,}880 + 150 = 3{,}030 \textit{ volts},$$

which corresponds for the entrefer to a m.m.f. of 5,800 ampere-turns.

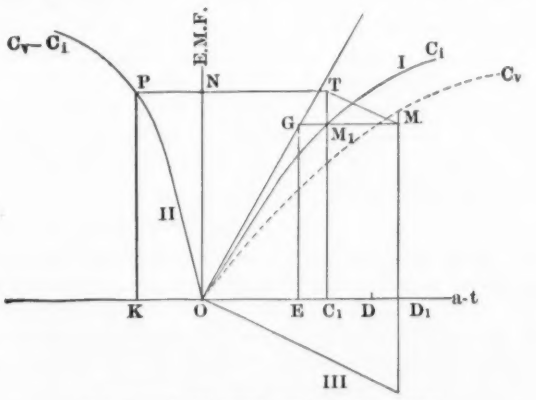


FIG. 5.—ARMATURE CHARACTERISTICS.

If one adds to this the ampere-turns necessary for the armature iron only, and the equivalent m.m.f., there is a total of

$$5{,}800 + 450 + 2{,}380 = 12{,}500 \textit{ ampere-turns};$$

The graphic construction gives then for the field magnet an m.m.f. of 3,870 ampere-turns, from which:

$$8{,}630 + 3{,}870 = 12{,}500 \textit{ ampere-turns};$$

that is to say, an approximation of 4 per cent., which is in fact yet larger, since we estimate the power factor as equal to zero instead of from 0.15 to 0.25.

Messrs. Hobart and Punga get a result about 14,000; that is to say, an error of 17 per cent. This error is evidently not very great in the actual working case, but only because the saturation of the teeth and of the field magnet is not excessive, the working point being only about the middle of the bends of the magnetic curves.

With the field magnets above the bend of the characteristic, on open circuit, the errors would be very serious, which indicates that the equivalent m.m.f. and the e.m.f. of dispersion are too large. It ought to be remarked, moreover, that it is above all the influence of the latter which is felt in the predetermination of the characteristics on completely inductive load.

It is then very necessary to increase the precision of the calculation by obtaining, experimentally, as we have done, the e.m.f. of dispersion.

Remark.—It should be added that Messrs. Hobart and Punga take

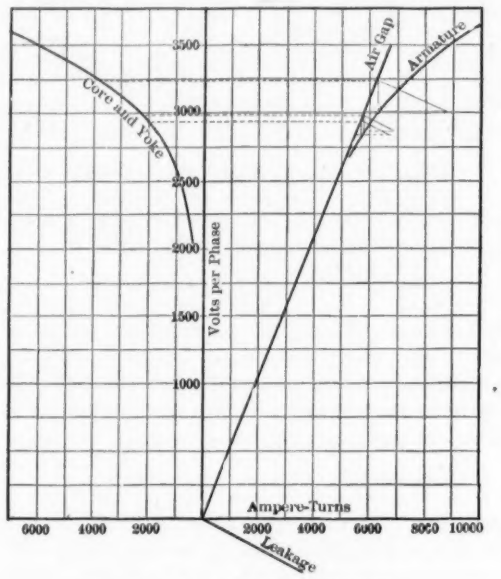


FIG. 6.—LOAD CHARACTERISTICS.

for granted that the stray field of the field magnet is due to the sum of the ampere-turns placed on the field magnets, which is true only of very weak saturations.

This method is, moreover, similar to that suggested in 1898 and 1899 by Profs. Arnold and Blondel.

In reality, as Figs. 4 and 5 demonstrate very clearly, the stray fluxes are due to the ampere-turns corresponding to the drop of magnetic potential in the entrefer and the armature and to the ampere-turns, $f_1 \sin \Psi$, that should be added to balance these demagnetizing ampere-turns. This gives a smaller proportion for the augmentation of the stray fluxes with the load, with the result that, without this still incomplete manner of proceeding, the methods of these authors would give results still less exact.

Our method of deducing the characteristic of the field magnet differentially is, on the other hand, as we have already shown,[9] beyond all criticism so far as concerns the variation of Hopkinson's coefficient with saturation.

CONCLUSION.

To sum up, it is clear from the preceding that the method advocated by Messrs. Hobart and Punga does not give practical results

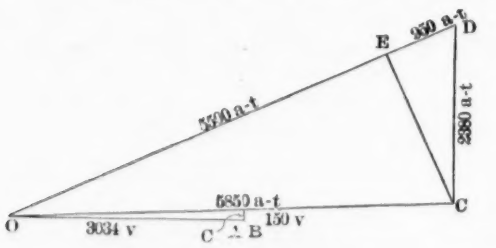


FIG. 7.—VOLTAGE DIAGRAM.

sufficiently approximate when the saturation is increased, on account of the too high values both of the equivalent m.m.f. of the armature and of the e.m.f. of dispersion. It is not more exact than the methods which use only the characteristic on open circuit and the characteristic on short circuit, for the consideration of partial characteristics only permits the escape from the hypothesis that the total magnetic resistance is the same on open circuit as on load for a given flux in the armature.

[9] *L'Eclairage Electrique*, loc. cit.

It is not without interest to note that this principle was pointed out to me by the learned Prof. Potier, and that M. Picou and I have been the first to apply it—M. Picou to the theory of continuous-current dynamos and the author to the theory of alternators and continuous-current dynamos.

Data of the Alternator of the Central London Railway.

Apparent power in kilowatt-amperes	850
Nature of currents	Three-phase
Pressure at terminals, in volts	5000
Pressure per phase, in volts	2880
Strength of current in amperes per phase	98.5
Angular speed in turns per minute	94
Frequency in periods per second	25
Field Magnets.	
Number of field magnet poles	32
Diameter of the field magnets in the entrefer, in cms	364.4
Polar pitch, in cms	36
Shape of polar pieces	Rectangular
Ratio of width of pole to polar pitch	0.633
Dimensions of the polar pieces, in cms	22.8x37
Surface of polar pieces, in sq. cms	845
Form of section of polar cores	Rectangular
Dimensions of section of polar cores, in cms	16.5x37
Section of polar cores, in sq. cms	610
Height of polar core, in cms	25
Armature.	
Simple entrefer	8
Diameter of the armature bore, in cms	366.6
Total width of the armature cores (with ventilating ducts)	36.8
Actual width of the armature cores	27.4
Number of slots per pole	6
Nature of slots	Grooves rectangular
Radial height of slots, in mm	92
Width of slots, in mm	33
Width of slots of entrefer, in mm	33
Nature of armature winding	Coils
Number of coils in each phase	16
Number of turns per coil	28
Number of conductors per slot	14
Nature of conductors	Wire
Length of a turn, in cms	161
Inner part, in cms	55
Outer part, in cms	106
Resistance per phase at 60° C.	0.33

Recent Station Equipment of the Worcester Electric Light Co., Worcester, Mass.

Within the past year or two the Worcester Electric Light Company has made several important additions to its station equipment. Until recently all the alternating-current generators in use at the Faraday Street plant were belted machines of the single-phase type driven from line shafting, which also furnished power for operating the direct-current arc dynamos and 500-volt generators used in the plant. Single-phase distribution is at present in force in Worcester, but the old alternators have been superseded by three-phase generators of the revolving-field type. Arc lighting is still handled by Brush machines and 500-volt, direct-current dynamos have been retained for general power service.

The new equipment consists of one 1,200-kw and one 800-kw direct-connected alternator, one 250-kw belted alternator, a 500-kw synchronous motor and the necessary exciters, a 19-panel switchboard, two new engines and two additional boilers. The latter are of the horizontal return tubular type, rated at 200 hp each, with 18-ft. tubes and a width of 72 in. They were made by William Allen & Sons, of Worcester, and are of similar design to the eight boilers previously installed in the plant.

All the electrical equipment is of General Electric manufacture. The 1,200-kw alternator is direct-driven by a 30-in. by 60-in. by 48-in. horizontal cross-compound Providence Corliss engine making 90 r.p.m. This engine is fitted with cylinders of hard, close-grained charcoal iron, a cast-iron girder frame and a forged wrought-iron shaft 22 in. in diameter at the bearings and 25 in. at the center. The pistons have adjustable packing and the low-pressure jump ring is babbitted on the bottom side. The cylinders are steam jacketed and provided with water relief valves. The high-pressure piston rod is 6½ in. in diameter and the low-pressure rod 8 in. Double eccentrics are provided on each side of the engine. The crank and crosshead pins are made of open-hearth forged steel, the diameter of each being 10 in. and 8 in. respectively. Both are 10 in. long. The engine is built to carry 150 pounds working steam pressure, and the guaranteed dry steam consumption at 125 pounds steam pressure, 26-in. vacuum and 90 r.p.m., is not over 13½ pounds per indicated hp-hour. The bearings are 22 in. by 38 in., water-jacketed. An intermediate vertical receiver is installed in the basement. An easy maximum for the engine is 2,000 hp. The alternator to which it is coupled is an 80-pole, revolving-field, 60-cycle, 2,300-volt machine, with a total weight of

218,100 pounds. The foundation plates weigh 10,100 pounds, the armature 87,000 pounds and the revolving field 121,000 pounds. The efficiency guarantee of the machine is: half load, 92 per cent.; three-quarters load, 94 per cent., and full load, 95 per cent. The full-load regulation is 8 per cent. voltage drop at 100 per cent. power factor. The guaranteed temperature rise is not over 40° C. after 24 hours' run at full load, and 55° C. after 2 hours' run at 25 per cent. overload, the temperature of the surrounding air being 25° C. An insulation test of 1,500 volts alternating current was applied to the field and frame and 5,000 volts alternating to the armature coils and frame. The alternator requires 27 kw excitation at 125 volts when operating at 50 per cent. overload. The fly-wheel effect of the revolving field is 121,000 pounds at 9.5 ft. radius of gyration.

The 800-kw alternator is also an 80-pole machine making 90 r.p.m. It is driven by a 26-in. by 52-in. by 48-in. Providence Corliss engine of similar design to the one above described. The shaft of this engine is 22 in. in diameter at the center and 20 in. at the bearings. The latter are water-jacketed and are 20 in. by 38 in. in dimensions. The crank pins are 8 in. in diameter and 10 in. long, the corresponding dimensions of the crosshead pins being 6½ in. by 10 in. The new engine replaces an old 26-in. by 48-in. by 48-in. Corliss, which was used to drive the line shafting. The latter has been sold by the company. The guaranteed steam consumption is the same as above and an easy maximum for this engine is 1,500 hp. The alternator is a 2,300-volt, 60-cycle machine of similar design to the 1,200-kw generator. It requires 22 kw excitation at 125 volts when carrying 50 per cent. overload. The temperature guarantee and insulation tests are the same as above stated, and the efficiency, 91.5, 93.5 and 94.5 per cent. at half, three-quarters and full load, respectively. The weight of the revolving field is 92,000 pounds; that of the armature, 68,400 pounds; foundation plates, 10,000 pounds, and total weight, 162,400 pounds. The full-load voltage regulation is 8 per cent. at unity power factor. The fly-wheel effect of the field is that of 92,000 pounds at 8.3 ft. radius. The 250-kw belted alternator is a standard three-phase, 2,300-volt, 60-cycle machine of the revolving-field type.

Two exciters are provided, each one being capable of supplying all the field current needed by the alternators. One of these is a 50-kw, 125-volt generator, belt-driven from line shafting, and the other a set consisting of a 4-pole, 50-kw, 125-volt, direct-current dynamo, direct-connected to a 10-pole, 75-hp, three-phase, 2,080-volt induction motor.

The 500-kw synchronous motor is a 26-pole, 60-cycle, 2,300-volt machine of the General Electric Company's type D-52. Its normal speed is 277 r.p.m. and it is adopted to either drive or be driven by a 7-in. line shaft located in the basement. The machine thus may be run as a three-phase motor or as a three-phase generator, and it constitutes an extremely flexible addition to the station equipment. It has a revolving-field, stationary armature, and an 8-pole, 13-kw exciter mounted on its shaft. At 100 per cent. power factor the temperature rise after a 24-hour run at full load is guaranteed not to exceed 40° C., and after 2 hours' run at 25 per cent. overload, 55° C., the surrounding air being at 25° C. A 1,500-volt insulation test was applied to the field and 5,000 volts to the armature. The voltage regulation of the machine is 8 per cent., and the guaranteed efficiencies, 90.5 per cent. at half load, 93 per cent. three-quarters load, and 94 per cent. full load. The total weight of the machine is 22,700 pounds, of which 6,200 pounds is charged to the base, foundations and plates, 8,500 pounds to the stationary armature and 8,000 pounds to the revolving field. The fly-wheel effect of the field is that of 34,000 pounds at 2 ft. radius. The line shafting is so arranged that any one of the three belted Corliss engines that are used for driving it may be connected to operate the synchronous motor as a generator. These engines are not a part of the new equipment, but consist of an 18-in. by 34-in. by 48-in., a 20-in. by 40-in. by 48-in., and a 22-in. by 44-in. by 48-in. engine, all making 70 r.p.m.

The switchboard is built of blue Vermont marble, with a dull black navy finish, which is exceedingly comfortable to the eyesight of the operators in comparison with the lighter colored board, which formerly occupied the same place in the plant. It consists of 5 generator panels, 2 exciter panels, 1 Tirrell voltage regulator panel, 1 power feeder panel, 1 synchronous motor panel, 1 induction motor panel and 8 single-phase feeder panels. In the basement directly below the switchboard are installed form K 2,500-volt automatic oil switches set in brick compartments for the generator control. These switches are operated by 110-volt, direct-current motors controlled by switches on the generator panels above. Red and green pilot lamps are provided to show when the current is on and off respectively. The feeder circuits are also equipped with oil switches, mounted on the rear of the switchboard. The low-voltage, motor-operated control was adopted on the generator panels to eliminate the risk to attendants in handling the 2,300-volt circuits.

A Berkeley twin jet condenser takes care of the 1,200-kw unit and a Knowles jet condenser officiates in connection with the 800-kw outfit.

The Law Relating to the Escape of Electricity.

By W. Valentine Ball, M.A., *Barrister-at-Law.*

AMONGST the legal problems to which the use of electricity has given rise, perhaps there is none of greater interest than the question whether and how far an electric supply company can be held liable for the damage caused by an escaping current. The solution of the question is by no means free from complexity, either in England or America; and it may, therefore, be profitable to discuss, in so far as it is possible to do so within the scope of a short article, the principles which appear to have been adopted by the courts. As will presently be shown, the legal principles which decide the question appear to be the same on both sides of the Atlantic. Having reviewed the cases which have arisen in relation to the escape of powerful amounts of electricity, we shall hope to discuss the questions which are likely to arise in connection with the transmission of wireless messages.

A powerful current of electricity which is passing along the mains of a supply company, or returning through earth, may do mischief in one of two ways, e. g., by induction, as in the case where it affects the working of telegraphic apparatus, or by setting up electrolytic action, by which iron pipes beneath the soil belonging to gas or water companies are sometimes corroded. If damage is caused in either of these ways it is necessary to see whether the company which has generated the escaping current can be held responsible in any and what degree. It is proposed to approach this question, in the first instance, without regard to the statutory protection, express or implied, which is so often conferred upon a company or municipality, who are carrying out a public work for the public benefit.

In England it has been declared that any man who brings anything on to his land which may escape and do damage to his neighbors' property, must keep it there at his peril, and the very fact of its escaping is *prima facie* evidence of negligence. This principle was settled in relation to water in the case of Fletcher v. Rylands (1868, L. R. 3 H. L. C., 330). There the defendant had made an artificial lake on his estate. The water broke through and flooded certain shafts in a mine belonging to the plaintiff. The defendant was held liable. Mr. Justice Blackburn stated the principle to be that anyone who brings on to his property something which is not naturally there, harmless to others so long as it is confined to his own property, but which he knows to be mischievous, if it gets on his neighbors' land, must keep it in at his peril, "and ought to be obliged to make good the damage which ensues if he does not succeed in confining it to his own property." It was of the very essence of this decision that the plaintiff was injured through no fault of his own. Quoting Mr. Justice Blackburn, Lord Cavin, in giving judgment in the highest legal tribunal in England, the House of Lords, said at p. 340 of the report: "The person whose grass or corn is eaten down by the escaping cattle of his neighbor, or whose mine is flooded by the water from his neighbor's reservoir, or whose cellar is invaded by the filth of his neighbor's privy, or whose habitation is made unhealthy by the fumes and noisome vapors of his neighbor's alkali works, *is damnified without any fault of his own.*"

The principle of Fletcher v. Rylands, modified, as we shall endeavor to show, in a very material particular, has been applied to electricity both in America and England, and the fact that the question of its application to electricity was first raised and decided in America is but one further illustration of the start which America has had over England in the race for supremacy in the matter of electrical development.

That the doctrine of Fletcher v. Rylands, even in relation to escaping water, was received, but only with an important modification in America, appears from the case of Pixley v. Clarke (32 Barbour's New York reports). There the court held as follows:

"Individuals owning the bed of a stream, and each bank thereof have a right to build a dam and embankment, and to raise the water of the stream as high as they please, subject only to restriction resting upon all, so to enjoy their own property as not to injure that of another person, with the qualifications and limitations incident to that right of property. And if in the exercise of that right they build with due care an embankment to prevent the water when raised by their dam above the natural banks of the stream, from overflowing the lands of adjacent owners, and in consequence of raising their dam the water finds its way through their own natural soil, and below the surface thereof, by filtration, percolation or otherwise, to the land of an adjacent proprietor, the owners of such dam and embankment are not, in the absence of any unskillfulness, negligence or malice, liable to such adjacent proprietor for any damage he may sustain thereby, the injury being *damnum absque injuria.*"

In the case of Cumberland Telephone & Telegraph Company v. United Electric Railway Company (1890), 42 Fed. Rep. 273, the head note was as follows: *"In the present state of electrical science* a telephone company cannot maintain a bill for an injunction against the operation of an electric railway to prevent damages incidentally sustained by the escape of electricity from its rails." The importance of the words printed in italics will presently be realized. The facts of this case may be thus epitomized: The plaintiff telephone company had obtained legislative authority to construct and maintain telegraphs and telephones, or other lines necessary for the speedy transmission of intelligence along and over certain highways in Nashville, Tenn. Defendants were five street railways, all operated by electricity, under the Sprague and Thomson-Houston systems, and using a trolley or overhead wire. By an act approved March 21, 1887, amending the general incorporation laws, all street railways thereafter organized under the general laws of the State were authorized to propel their cars by electricity. By another act, approved February 28, 1899, all street railway companies which before that time had operated cars by animal power, were empowered to operate the same by electricity, provided the city gave its assent. Acting under this supposed authority one of the defendants, the McGavock & Mt. Vernon Company, proceeded to equip a portion of its road with electricity. Thereupon and on April 17, 1889, the complainant filed a bill in the Chancery Court to enjoin it. Before the cause was heard the parties entered into an agreement by which the telephone company agreed to dismiss its bill, to elevate all its wires which might interfere with the operation of the road, to use all means to prevent their wires from coming in contact with the trolley wires of the road, and not to interfere further with the operation of the road, the railroad company agreeing, upon its part, to construct at its own expense a return metallic circuit, for the use of the telephone company, "whenever it is ascertained that its service is being injured by electricity generated by the railway company, and to use all necessary precautions to prevent the telephone wires from coming in contact with its own wires. In January, 1890, a similar agreement was made between the telephone company and the City Electric Railway, with a proviso that if, upon a fair trial, the return wire should not protect the telephone company from substantial injury, the parties should be remitted, without prejudice, to their legal rights and remedies as they existed before the agreement was made. The action was brought to determine the nature of these legal rights. It was alleged that the metallic current has not given the relief anticipated, and that the complainant was not estopped by the agreement. It was asserted that the electricity returning through the earth reached the wires of the telephone company through various agencies, and that this current produced load lagging noises and greatly interfered with the accurate working of the instruments. It was also averred that the service was interfered with by induction, where a varying current of electricity, conveyed on a conducting wire, will produce in a parallel wire other amounts of electricity. The defendants, among other pleas, urged that the complainants were not entitled to a monopoly of the earth for its return circuit, and insisted that it should make use either of a complete metallic circuit or of a device known as the "McCluer Device" for its return circuit.

After a lengthy review of numerous cases bearing upon the point, Brown, J., said: "The substance of all the cases we have met with in our examination of this question is that, where a person is making lawful use of his own property, or of a public franchise, in such a manner as to occasion injury to another, the question of his liability will depend upon the fact whether he has made use of the means which, in the progress of science and improvement, have been shown by experience to be the best; but he is not bound to experiment with recent inventions, not generally known, or to adopt expensive devices when it is within the power of the person injured to make use himself of an effective and inexpensive method of prevention. If, in the case under consideration, it were shown that the double trolley would obviate the injury to the complainant without exposing the defendants or the public to any great inconvenience or a large expense, we think it would be their duty to make use of it, and should have no doubt of our power to aid the complainant by an injunction; but, as the proofs show that a more effectual and less objectionable and expensive remedy is open to the complainant, we think the obligation is upon the telephone company to adopt it, and that the defendants are not bound to indemnify the complainant; in other words, that the damage incidentally done to the complainant is not such as is justly chargeable to the defendants. Unless we are to hold that the telephone company has a monopoly of the use of the earth, and of all the earth within the city of Nashville for its feeble current, not only as against the defendants, but as against all forms of electrical energy which in the progress of science and invention, may hereafter require it use, we do not see how this bill can be maintained." In the event the injunction was refused. It is conceived, however, that the result might have been otherwise if the telephone company had been unable to effect an improvement by a comparatively slight modification of their system.

The law in America seems to have been well and succinctly stated by Judge Woodworth, in Panton v. Holland (7 Johns. 92) where he said: "On reviewing the cases I am of opinion that no man is answerable in damages for the reasonable exercise of a right, when it is accompanied by a cautious regard for the rights of others, when there is no just ground for the charge of negligence or unskillfulness, and when the act is not done maliciously."

Mr. Simon Croswell, in his admirable work, "The Law Relating to Electricity" (1895), gives references to a number of cases which are analogous to the above, and says (p. 213): "In almost every instance the courts have held that the telephone company should make the necessary change, because the telephone, as a species of telegraph, uses the highways in subordination to the right of public to travel thereon, and the electric railway is a form of this travel."

We have said that American lawyers have recognized the principle of Fletcher v. Rylands, but the above case will show that they have only done so to the extent that a man who brings anything on to his own land must use the best means known to science to prevent its escape; if, after such precautions, there be an escape, it becomes the duty of a neighbor to protect himself as well as possible.

After passing through a certain period of doubt and hesitation, the English courts appear to have arrived at the same conclusion. The point was first raised in the case of the National Telephone Company, v. Baker (1893) 2 Ch. 186. There a tramway company acting under a provisional order (i. e., under statutory authority) and using the then best known system of electrical traction (i. e., overhead wires and return through insulated rails), caused electrical disturbance in the wires of a telephone company. These disturbances prevented the telephone being used. It was proved at the trial that the use of a second wire by the plaintiffs would have completely cured the disturbances complained of, but it was also proved that nearly the whole of the plaintiff company's telephone business throughout the country was carried on by means of the single-wire system. An action having been brought by the plaintiffs, the defendants pleaded (as the defendants in the American [*ubi supra*] case had also pleaded) that an alteration of the plaintiff's system would have minimized the nuisance. With regard to this plea the judge said that inasmuch as the plaintiffs were carrying on their own business lawfully, he could not put to them the expense of altering it merely for the purpose of enabling the defendants to run their trains without creating a nuisance. As events turned out this opinion became a mere *obiter dictum;* that is to say, an expression of opinion which was not material to the issue, as the case was decided in favor of the defendants because they were expressly authorized by statute to use electrical power, and the learned judge held that the legislature must, therefore, have condoned by anticipation any mischief arising from the reasonable use of such power.

It was not until 1902 that an English court adopted the rule of law which, as we have seen, was laid down in America twelve years

before. In 1902 the case of the Eastern & South African Telegraph Company, Limited, v. the Cape Town Tramways Companies, Limited (1902, A. C. 381), came before the judicial committee of the Privy Council, on appeal from the Supreme Court at the Cape. There the defendant company owned certain tramways worked on the overhead wire system, and having uninsulated returns, which ran along the sea front in Cape Town and its suburbs. Part of the line was worked under statutory protection, and part of it was worked without statutory authority. The plaintiff company owned a submarine cable which runs out to sea through Table Bay.

It was found that at some point in Table Bay electricity having escaped and being at large, was attracted to the telegraphic cable. Entering the sheathing it found its way back to the tramway central station and so completed the circuit. While traveling along the sheathing the intensity of the current varied frequently at irregular intervals and gave rise to such induced currents in the core of the cable as to render it practically useless for the transmission of messages. In these circumstances the plaintiff company were put to great expense to effect a remedy, and in the event it was found that by laying a second cable parallel to the first all through the sphere of influence, the mischief was abated. They sought by action to restrain the tramway company from so carrying on their business as to be a nuisance, and incidentally to recover, by way of damages, the expenses to which they had been put in making experiments and laying the necessary protecting cable. Owing to the fact that a section of the tramway was worked otherwise than by statutory power, the question of the tramway company's liability in law was distinctly raised.

The Colonial Courts having found in favor of the defendants, the telegraph company appealed to the Privy Council. At the hearing the American case of Cumberland Telegraph & Telephone Company v. United Electric Railway Company (*ubi supra*) was referred to. The plaintiffs, however, relied upon the simple doctrine of Fletcher v. Rylands to give them a cause of action. In giving judgment Lord Robertson said: "If regard be had solely to the action of the respondents in storing electricity on their lands, it must be allowed that the analogy is very close to the illustrations given in Rylands v. Fletcher of the kind of things which an owner can only do at his own peril. Electricity is capable, when uncontrolled, of doing injury to life and limb, and to property; and in the present instance it was artificially generated in such quantity and it escaped from the respondent's premises and control. So far as the respondents are concerned, it appears to their Lordships that given resulting injury such as is postulated in Rylands v. Fletcher, and the principle would apply. But this is only half the question, and it remains to be seen if the injury postulated is present. * * * * The true comparison is with things used in the ordinary enjoyment of property, and this cable differs from such things in its peculiar liability to be affected by even minute currents of electricity. Having regard to the appellant's argument, it seems necessary to point out that the appellants, as licensees to lay their cable in the sea, and as owners of the premises in Cape Town, where the signals are received, cannot claim higher privileges than other owners of land, and cannot create for themselves, by reason of the peculiarity of their trade apparatus, a higher right to limit the operations of their neighbors than belongs to ordinary owners of land who do not trade with telegraphic cables.

"If the apparatus of such concerns requires special protection against the operations of their neighbors that must be found in legislation, the remedy at present invoked is an appeal to a common law principle which applies to much more usual and less special conditions. A man cannot increase the liabilities of his neighbors by applying his own property to special uses, whether for business or pleasure. * * * Nor need the law be regarded as showing any want of adaptability to modern circumstances if this be the true view, for the liability thus limited is of insurance."

Thus the courts of the two great English-speaking nations have arrived at the same conclusion on this all-important question.

Hitherto we have considered the question of liability independent of statute. Consideration of the authorities seems to warrant the conclusion that both in England and America the fact that electricity is being used under statutory power will excuse the company from liability. Liabilities on this head are as a rule only imposed where there is some element of negligence. In the Cape Town case, for instance, the company specially undertook by an agreement which was incorporated with and formed part of the statutory power under which they worked the greater part of their tramway, that in the event of any electric leak taking place and doing injury by electrolysis or otherwise, that they would make good the loss. In the opinion of the Privy Council, however, the injury done by the return current in the submarine cable was not the result of a leak. "It was," to use Lord Robertson's words, "on the contrary, a natural incident of the operations legalized under the statutes."

Thus has the law been settled and its settlement has been a matter of far-reaching importance to electrical companies of all kinds. It has compelled telephone companies to adopt the two-wire system and to adopt every other improvement which is capable to rendering the service immune from injury which might be sustained owing to the vicinity of heavy current mains. Nor has the above declaration of the law been without its effect upon subsequent legislation within the British Empire. By a statute recently passed in Natal a tramway company were specially enjoined not to so conduct their business as to cause any interference with a neighboring submarine cable.

With regard to electrolysis caused by escaping electricity, it will be at once appreciated that injury from this source can only be caused by the negligent laying or up-keep of mains; and it is conceived that no legislature would ever excuse an electric supply company from the consequences of such negligence. Upon this head we have only been able to find one case, namely, that of the Manufacturers' Natural Gas Company v. Indianapolis Street Railway Company, which was heard in Indianapolis, U. S. A., in 1901.* It seems to warrant the inferences (*a*) that there must be no negligence in the exercise of a franchise, and (*b*) that every possible precaution must be taken to prevent injury being caused by the escape of electricity from mains. The action there was brought to recover damage for injuries caused to gas pipes by electricity which had escaped from a badly insulated main. In the judgment there appeared the following passage: "The method in use by the defendants in operating their cars results in serious injury to and in some cases destroys the plaintiff's pipes. The defendants can, by use of an approved appliance at reasonable expense so operate their cars as to avoid injuring the plaintiff's pipes; while the plaintiffs cannot, by any known method, protect their pipes from injury. The plaintiffs own the pipe line laid in the street by legal authority, and such pipe line is property within the meaning of the constitution and laws. It is subject to taxation, and it may be sold and purchased like other property. The street railway company seizes on these pipes and makes use of them as a conductor for their return current, and, in so doing, greatly injures and in some instances wholly destroys them; and this is done under a claim that they are performing a public service under legal authority. Is not this a taking of private property for public use, for which just compensation must be made? These questions are new and we are without precedent in decided cases for our guidance, but it would be a reproach to our system of jurisprudence, and the administration thereof, if a situation could arise in which large and material injury should be done to legal rights, and destruction caused to property, while the law was powerless to apply a remedy. * * * Where a corporation is exercising a public franchise and does so in such a manner as to cause actual material injury to legal rights and destruction of property, *when at a reasonable expense, by the adoption of well-known and approved* appliances, the injury would be avoided, and the person injured is powerless to prevent or guard against such injury, then I think it must be held to be negligence in the use of its franchise on the part of such corporation not to adopt such approved appliances.

In England, however, the legislature has considered it expedient upon one or two occasions to expressly reserve this liability to the tramway company. Thus, Section 46 of the City of Birmingham Tramways Act, 1901, provides that, "If it be provided that any injury or damage to any gas or water pipes, or other metallic pipes belonging to the corporation, shall have resulted from fusion or electrolytic action caused by any currents generated or used by the company for the purpose of electric traction under this act, nothing in this act shall relieve the company from any liability to make compensation for any such injury or damage, which would not have existed but for the passing of this act."

Passing on to the question of wireless telegraphy, it is conceivable that the messages from a transmitter belonging to one person might affect and seriously incommode the working of a receiver belonging

*See *Traction and Transmission*, Vol. II. Sept. 1901, p. 4.

to some one else. In the light of the above statement of the law of escaping electricity, could any redress be sought? It is thought not. It may be true that in sending messages broadcast from a transmitter a man is discharging something (if such a word is appropriate) from his own property, which may be a source of inconvenience to his neighbor; but it is conceived that if any neighbor makes use of a receiver he must either be content to submit to interference with his messages or else take such precautions whether by "tuning" his transmitter or otherwise, as to prevent his instrument being affected. Such, it is conceived, is the principle of law applicable to wireless telegraphy. In using a receiver a man uses a highly delicate instrument, and if his neighbor's messages reach him accidentally he has no redress in law. There remains a question of greater nicety. Suppose the owner of a receiver of wireless messages records a message sent from a transmitter belonging to some one else, can he be restrained from making use of that message? No case in relation to telegraphs has arisen in England which is likely to give any clue to the solution of a problem of this kind. This is probably because the telegraph has so long been a government monopoly that no one has ventured to tamper with it. Further, an act of Imperial Parliament which was passed in the present year to bring the use of wireless telegraphy under state control, is silent with regard to the question under discussion.

With regard to America, although there are acts in force in some States which prohibit the disclosure of telegraphic messages, the writer has not been able to trace any measure which penalizes the stealing of a telegram; and there does not appear to have been any legislation with regard to wireless telegraphy in the United States.

Typical New Telephone Building at Newton, Mass.

Within the past few years the telephone business of Newton, Mass., has increased to an extent which has made necessary the desertion of the old central office on Centre Street and the occupation of a new building on Elmwood Street, near Eliot Hall. Newton is one of the most prominent of the residential cities and towns which make up suburban Boston, and has a population of about 35,000 inhabitants. It is divided into a large number of residential districts, among which are Newtonville, West Newton, Auburndale, Upper Falls, etc. Newton proper is seven miles from Boston and the telephone service falls under the suburban district of the New England Telephone & Telegraph Company.

The new office represents the latest central energy type of switchboard and power equipment and is a one-story building of red brick with a basement extending partly above and partly below the level of the street. In ground dimensions the building is 65 ft. 8 in. long by 32 ft. 8 in. wide. The first floor is given up to the operating room and quarters of the operators, the basement being devoted to the power and distribution equipment.

The incoming cables enter the building through a duct on the Elmwood Street side. There are eleven of these, composed of 6-400 pair, 4-180 pair and 1-30 pair lead-covered cables. The 30-pair cable is used chiefly for toll service. After entering the power and terminal room the cables make a 4-ft. run to the main distributing frame, which at present occupies a space 12 ft. 3½ in. long and 2 ft. 7¾ in. wide. It has a capacity on the horizontal side of 10 shelves with 360 pairs of terminals per shelf, and on the vertical side 19 arrester bars with 160 pairs per bar. The present equipment is 2,520 total pairs of terminals, and on the vertical side 1,700 pairs of arresters. From the main frame the cables pass to the intermediate distributing frame and relay rack, the coil rack and fuse board being located against the north wall, although a space of about 18 in. is left between the fuse board and the wall itself. The intermediate frame has a capacity of 12 shelves and 400 lines per shelf on the horizontal side, and 21 bars with 220 lines per bar on the vertical side. The present equipment aggregates 1,700 pairs of terminals on the horizontal and 1,420 pairs on the vertical side. The relay rack has a capacity of 9,240 relays, ultimately. There is a capacity of 13 shelves and 81 coils per shelf in the coil rack, with two condenser shelves carrying 240 condensers each. The fuse board has a capacity of 1,370 fuses, with the standard bus-bar alarm and local lamp signal for calling the trouble man's attention whenever a fuse blows. The relay rack occupies a space 11 ft. 6½ in. long by 3 ft. 2 in. wide; the intermediate frame is 11 ft. ¾ in. long and 2 ft. 6 in. wide; the coil rack is 14 ft. 8⅞ in. long and 16 in. wide, and the fuse board is 5 ft. 1 in. wide.

Current for talking and general signaling is supplied by a storage battery of the Chloride type, made by the Electric Storage Battery Company, and composed of 11 cells type G-11, giving 24 volts for local service. These cells are set up on a pair of stands in a battery room leading off the power and terminal room. The battery room is about 15 ft. long by 6 ft. 2 in. wide. For toll conversations there is a second battery, which consists of 11 cells of type E-11 plates, and which is connected in series with the larger battery to give 48 volts in long-distance work. The second battery occupies the same battery room as the first and it is set up on a stand 5 ft. 5¾ in. long and 12 in. wide. The dimensions of the larger stands are: For six tanks, type G, 10 ft. 8½ in. by 18⅜ in.; for five tanks, 8 ft. 10¾ in. by 18⅜ in. Two charging generators of equal design are provided. One is a Western Electric type M-4, 30-volt, 175-amp. generator, direct-connected to a Wagner 10-hp, 60-cycle, 104-volt, 1,800-r.p.m. induction motor. The other is belt-driven by a 12-hp White & Middleton gas engine. Each generator and motor is mounted upon a wooden sub-base set on a brick foundation, the floor of the power and terminal room being of concrete. These machines are controlled by a slate switchboard of Western Electric type, equipped with a Cutler overload circuit-breaker, two Weston 250 ammeters, one Weston 40 voltmeter, the necessary field rheostats, knife switches and an underload circuit-breaker. This switchboard also controls the ringing and signaling machines, which are mounted on a slate table in the northwest corner of the room, 3 ft. 9 in. long by 20 in. wide. There are two ringing machines, one of which can be belt-driven by a ⅓-hp Emerson single-phase, 60-cycle induction motor, operating at 104 volts and 1,150 r.p.m. The other machine is run off the battery by a 22-volt Western Electric direct-current motor making 1,000 r.p.m. An alternating voltage of 75 is supplied by the generator side of these machines for ringing. These machines also supply the current needed for the busy back, flash back and tone tests and the "howler" circuit, which notifies a subscriber when he forgets to return his receiver to its hook. The gas engine exhaust is carefully carried up through the roof with due regard to the fire risk, and the cooling water tank is located in an adjoining room in the basement. The gas engine foundation is 5 ft. 8 in. long by 1 ft. 8 in. wide, and the generator foundation is 2 ft. 9¼ in. by 34⅝ in. The power board is 6 ft. wide and the motor-generator foundation is 5 ft. 11½ in. by 2 ft. 5 in. in plan. Nearly half the basement is given up to storage room and to the maintenance department. The power and terminal room also includes a two-position test table.

From the power and terminal room the subscribers' and the auxiliary circuits pass in cable form to the main switchboard in the operating room through a hole in the floor 28 in. by 23 in. The construction of the building is of the mill type.

The operating room is lighted by either electricity or gas, and along the west wall stands the main switchboard. It is a seven-section Western Electric No. 1 central energy multiple board, with an ultimate capacity of 4,000 lines. The jacks are of the Western Electric pattern, the present equipment being 1,400 lines. There are now connected to the board 631 subscribers' lines serving 1,339 stations in Newton, Newtonville and Watertown. Ten positions of the board are now in use, the operating force consisting of 15 employes, two of whom are men who work nights. Each section has three positions. Of the stations now connected, 326 are business and 1,023 residence instruments. The trunk multiple has a capacity of 500 outgoing jacks, consisting of 20 per strip multipled every five bays with a designation strip below each strip of jacks. The present equipment of the trunk multiple is 200 jacks. Three of the operators' positions are "B" positions and here the incoming conversations are handled over trunks from other exchanges in the suburban district. One B position also handles trunks from old magneto offices, which are still in operation. The busy hour comes generally from 8.30 to 9.30 a.m. At present there are 99 incoming and 82 outgoing trunks connected to the board. In the busy hour 10 operators are required to handle the traffic. The service is of mixed classification on nearly all the positions of the board.

Both A and B positions are equipped with a circuit which enables any operator to converse with a supervisor where she so desires. The operator simply plugs into a jack in the multiple in front of her; this lights a supervisor's lamp in the upper part of the board, and the supervisor plugs into a jack in the keyboard to converse with the operator in question. No disturbance is created by this method, which has now become standard Bell practice. There are two lamps for this purpose in each section covered by a supervisor

and the buzzer is located behind the switchboard. Flash back signals are also used now in standard B board practice to notify an A operator at an outside exchange or office whether the local line desired is busy or out of order. This signal comes in over the designated trunk and flashes the A operator's B subscriber's supervisory lamp. Upon the character of the flash depends the information conveyed.

In the operating room are also an information table, a manager's desk and a clerk and chief operator's desk. The information table is equipped with the usual card catalogues of addresses, 10 inward lines from A board at Newton, two to Newton Highlands and two to West Newton; lines to the chief operator, manager and wire chief; two outgoing lines to the A board and four outgoing lines to the B positions. The manager's desk connects with the switchboard by two lines, and has one line each to the chief operator, information table and inspector. The chief operator's table is equipped with lines to the switchboard, manager, etc., and has provision for observing the service.

The retiring room for the operator is equipped with fire-proof metal lockers, a gas stove, toilet rooms and resting chairs. Fire extinguishers of the Badger type are used plentifully in the office, as are dry powder extinguishers, asbestos blankets, dogskin gloves and asbestos barriers between the cord shelf and the multiples of the main switchboard.

The manager in charge of the Newton office is Mr. S. P. Swan. Toll connections are completed through the toll operators at Boston main.

The Present Relations of Physics and Electricity.

In the course of his lecture before the New York Electrical Society on November 30, Prof. W. H. Hallock said: It is in general not very profitable to spend much time in evolving an elaborate classification of the sciences and their inter-relations, nevertheless it may at times be well to take a survey of the situation, a sort of birdseye view without any especial reference to the boundaries, which are artificial and merely useful for ready reference. In a way "physics" should be considered to include both the branches which we refer to under the name of physics and chemistry. Phusis and phusikos and ta phusika refer to the essence of all matter and its nature; nevertheless, one branch of the subject has so grown out of proportion to the original trunk science that it occasionally forgets its relationship. We may say that the structure of the "atom" of the chemist, the ultimate nature of primordial matter, is considered in the domain of physics, while chemistry busies itself with the combinations of these atoms into molecules, the results of the combinations of the molecules into masses and their behavior as such is again physics. Every great generalization, every marked step toward the goal has been in the nature of a simplification, a reduction of the number of the unrelated phenomena of nature. Usually we think of physics as dealing with elementary mechanics, sound, heat, light, electricity and magnetism. Sound has long since been properly classed as a particular case of the mechanics of elastic matter; heat and light and most of the phenomena of electricity and magnetism have been similarly relegated to the domain of the mechanics of the "ether," and no one doubts that the other outstanding puzzle, gravitation, will also fall into this class. It is then the mechanics of the ether which must hold the solution of all our conundrums, and that is the direction in which the vast majority of investigators are struggling at the present time. What are the relations of matter and ether, or are they identical? That is the question.

In the latter part of "the seventies" Sir William Crookes made a brilliant series of experiments upon what he then called "radiant matter." He showed very beautifully that when the greater part of the air is pumped out of a glass tube, and then a current of electricity sent through the gas by means of the electrodes, as *A K* in the cut, that under these conditions there were sent out from the cathode small particles of matter, traveling at high velocities in straight lines until they struck the other side of the tube, or some intervening object. Ten or fifteen years later the investigation of this "radiant matter" was taken up more vigorously and Lenard found that by placing a small aluminum window opposite the cathode, he could cause the "cathode particles" to pass through the metal and travel some distance through the outside air. It had also been found that these particles carried a charge of negative electricity, and were consequently deflected by a static electric charge or by a magnetic field. In the last decade of the last century Röntgen discovered that where one of these particles was stopped by striking upon some object a new form of radiant energy was sent out. Not knowing its nature he called it X-rays, being recognized the world over as the "unknown quantity." Becquerel soon after discovered that uranium emitted a sort of radiant energy, which was then called "Becquerel rays." In the meantime the "radiant matter" of Crookes had come to be known as "cathode rays" and Goldstein had shown that a corresponding condition of matter carrying positive electricity could be produced, and called it "canal rays." We have then the cathode rays, particles of matter carrying negative charges; when one of

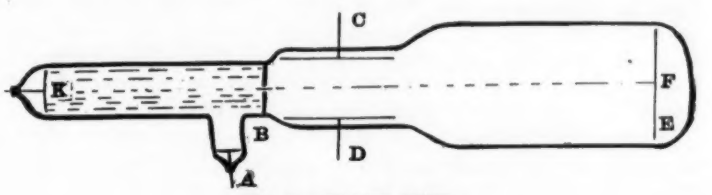


FIG. 1.—BRAUN TUBE.

these particles strikes it produces a few waves in the ether—an "ether pulse," as when a stone is thrown into a pool of water; this is X-rays. The radiations from radium and its analogues were soon identified as follows: The α rays are particles of matter carrying charges of positive electricity, traveling with a velocity of about 20,000 miles per second, and about the size of two atoms of hydrogen. It would take $5 + 10^{23}$, i. e., 5 followed by 23 ciphers of these α particles to weigh one gram (a gram is equal in weight to about 15 grains). The α particles have a very slight penetrating power; two ten-thousandths of an inch of aluminum, or a sixth of an inch of air, will cut off half the α radiations. The β radiations are the radiant matter of Crookes, the cathode rays of the present, particles of matter carrying negative electricity; traveling with a velocity of 160,000 miles per second, they are only one two-thousandths the size of the α particle and are much more penetrating, one-half passing through a fiftieth of an inch of aluminum or two inches of air. The γ rays are like X-rays, a pulse in the ether, and travel with the velocity of light, 186,000 miles per second.

By the deflection of the α and β particles under the influence of a static field or a magnetic field, it has been possible to determine the above facts, and many other independent phenomena confirm them most beautifully.

When a current of electricity is sent through a solution of common salt the molecules are immediately involved in a series of interchanges; all the atoms of the element sodium immediately start

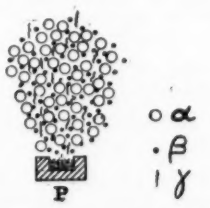


FIG. 2.—DIAGRAM OF RADIUM EMANATIONS.

toward the negative plate, because they carry positive charges, and all the atoms of chlorine start in the opposite direction toward the positive plate, because they carry negative charges. Thus the mechanics of electrical conduction is a procession of positively charged particles, ions, traveling in one direction and a corresponding procession of negative ions in the opposite direction. This is the only way non-metals can conduct electricity. Air is ordinarily a non-conductor; it is not a metal and it has no positive and negative ions. Under the bombarding influence of the radiations above described, the air is broken up into ions and becomes a conductor, and its conductivity is a measure of the activity of the bombardment. Consequently we may use the conductivity imparted to air as a measure of the degree of radioactivity.

Prof. J. J. Thomson puts forward the hypothesis that the small particles of the cathode rays are the primordial form of matter from which all the elements are built up, and proposes the name of "corpuscle" for them, but they are generally called "electrons." He even suggests very beautifully that the electron may be nothing more than a charge of negative electricity, and that when we have about a thousand of these combined with a neutralizing amount of positive electricity, we have an atom of hydrogen, 16,000 gives oxygen, etc.

When a gas is ionized, for example, by a β particle, it has one of its electrons knocked off, and consequently is left effectively positive, and the conditions are fulfilled for conduction of electricity.

The researches of Rutherford, Soddy, Thomson, Ramsay and many others have led to the following hypothesis as to the mechanics of radioactivity. The very large atom of radium, some 235 times as large as the hydrogen atom, is in a condition of unstable equilibrium, undergoing gradual disintegration, owing to a loss of some of its original internal energy. The first observable product is a gaseous material called by Rutherford "emanation"; this gradually disintegrates further, and as an end result we obtain helium, a very light inert gas, recognized by its spectrum. There are certainly other products, but they are not in sufficient quantity to be identified. Prof. Rumsay has gone even farther, and thinks it possible that elements may be built up by bombarding into an element of lower atomic mass a certain number of α and β particles.

If these hypotheses prove tenable it would appear that all physics, all matter, everything is electricity, and there is nothing in the so-called material universe but the ether and its mechanics

A long discussion followed, during which Prof. Hallock gave some most interesting additions to the subject matter of his valuable lecture.

In the illustrations herewith *A B C D E F K* is a "Braun tube." *A* is the anode; *K* the cathode; *B* a partition with a small circular opening; *C D* are wires connecting with two parallel aluminum plates inside the tube, and *E F* is a screen of fluorescent material. Between *K* and *B* are "cathode rays." *K F* is a stream of cathode rays which pass through the opening of *B* and when undisturbed strike the screen at *F*. If *C* is given a strong charge of negative electricity and *D* a corresponding positive charge, then the particles, "electrons" of the cathode rays passing between these plates will be repelled by *C* and attracted by *D* and strike the screen at about *E*, because the electrons carry negative electricity. A (small circle) represents the large particles sent out by radium, carrying a charge of positive electricity, and traveling with a velocity of about 20,000 miles per second. B (small black dot) represents the electrons sent out by radium, carrying a negative charge and traveling with a velocity of about 150,000 miles per second. Γ (the long wigglers) represents the γ rays or electric pulses (X-rays) sent out by radium and traveling with the velocity of light, 186,000 miles per second. The α particles are about twice as large as an atom of hydrogen and the electrons are about one-thousandth of the size of the atom of hydrogen. *P* represents a lead box containing radium.

Technical Society of the Pacific Coast.

The autumnal meeting of the Technical Society of the Pacific Coast, held in San Francisco on December 1, 2 and 3, was arranged to be of special interest to electrical engineers. Members of other engineering societies were invited to participate in the sessions. The convention was opened in the Mechanics' Institute Library on the evening of December 1, with President George W. Dickie in the chair. He welcomed the guests and members and advocated holding the spring meetings outside of San Francisco, suggesting Seattle as a suitable place for the next spring convention. The rest of the evening was devoted to a very interesting paper, illustrated by stereopticon lantern slides, on "Hydro-Electric Power Development and Transmission in California." Mr. Robert McF. Doble was on the programme to present the paper, but as he was unavoidably detained in the East, it was read by his brother, Mr. William A. Doble, president of the Abner Doble Company, of San Francisco, who, in introducing the subject, called attention to the tendency in hydraulic work, as pertaining to electric generation, to follow other lines of engineering that were more firmly established. For example, the idea of a receiver or distributer that at first was deemed necessary in all high-head plants, and which has since been discarded, was taken directly from steam engineering practice. He spoke of the exceedingly rapid development of hydro-electric plants, and said that the science had grown from rough engineering as instanced in many of the pioneer plants, to rank with the best practice in other lines. The reliability of the equipment had also increased.

Mr. Doble then took up the various hydro-electric power and transmission plants of California, treating them chronologically from the first installations on San Antonio and Mill Creeks in Southern California, known respectively as the Pomona and Redlands plants, and following up with the important stations, concluding with the De Sabla power house of the California Gas & Electric Corporation, which embodies the very latest types of modern construction. The distinguishing features of each system were pointed out, especially in reference to the improvements upon previous installations, and the increase in size of units, head utilized and length of transmission. In speaking of the De Sabla station he called attention to the last unit installed, comprising a 5,000-kw revolving-field alternator directly driven by a single tangential water wheel, the largest water wheel ever constructed on a single runner. Although built for a normal load of 5,000 kw, this unit delivers continuously 5,500 kw, this power being furnished from a single 6-in. jet of water. The slides illustrated many of the plants and some of the special features of the later ones.

At the Friday afternoon session Mr. James C. Bennett presented a paper entitled "Electrical Power, Generation and Transmission from the Standpoint of the Consumer," in which he dwelt chiefly on the installation and operation of motors driving roasting furnaces and blowers in smelting plants. The paper was briefly discussed by R. W. Myers, George W. Dickie, Frank P. Medina and others. A paper on "Water Power and Electricity in California," by George W. Nichols, was not presented owing to the author's absence.

Other papers read before the convention were as follows: "Engineering and the Law," by Frank P. Medina; "Trade Schools," by Edward T. Hewitt; "Phenomena of Machine Operation," by John Richards; "Durability of the Materials of Masonry Used in San Francisco," by Marsden Manson; "Collimating and Azimuthing a Modern Gun," by Otto von Geldern. The last paper was especially interesting, as it described a method devised by the author and used on all the modern guns of San Francisco harbor fortifications for their adjustment and alignment. At one of the sessions F. H. Newell, chief engineer of the United States Reclamation Service, was present and spoke interestingly on the water rights and laws of California. The convention, which was regarded as quite successful, was brought to a close on the evening of December 3 by a banquet at the Occidental Hotel.

Revision of the National Electrical Code.

At the annual meeting of the Electrical Committee of the Underwriters' National Electric Association, held in New York December 7 and 8, the Code of Rules and Requirements for the installation of electric wiring and apparatus was revised in several important particulars and a good many minor changes were made. Some radical suggestions for amendments were strongly opposed by the central station men and contractors and after some discussion were rejected by unanimous vote.

The report of the committee on car wiring was accepted—this recommended that all proposed amendments to the rules on this subject be referred to the Joint Conference Committee for consideration, and that no material change be made in Rule 32 until at least one year has elapsed and the rule has had a fair trial.

The reports of the Committee on Switches and Cut-outs and the Committee on Test Specifications for Rubber-Covered Wires were also accepted. The Switch and Cut-out Committee recommended raising the melting point of enclosed fuses to 25 per cent. above the continuous carrying capacity; also the amendment of Rule 1 by adding a section requiring terminal blocks on all electrical machines to be made of approved fire-proof insulating material, such as slate, porcelain or marble.

The Committee on Rubber-Covered Wires recommended that the rules be amended to require each foot of the rubber covering to withstand for five minutes the application of an e.m.f. proportional to the two-thirds power of the thickness of the insulation for coverings of 1/16 inch and over; below 1/16 inch, empirical test voltages of 3,000 volts per 1/64 inch are specified.

The report of the Underwriters' Laboratories, recommending no change in present requirements for insulating joints, was adopted, but their suggestion as to the omission of insulating joints on grounded systems was referred to a special committee for consideration, on the motion of Mr. Arthur Williams, of the New York Edison Company.

The rule regarding leads from central station generators to switchboards was amended by adding a fine-print note to the effect that such leads may be put in a conduit, a smooth runway being desirable, but that lead-covered cable may be used without any conduit if the

lead sheath be not allowed in contact with any object tending to abrade it.

A suggestion for an amendment requiring the casings of all transformers in central and sub-stations to be grounded with conductors equal in carrying capacity to the largest fuse in the high-potential circuit was regarded favorably by the committee, but upon explanation by Mr. Alex. Dow, of Detroit, that in many cases there were no fuses in the high-potential circuit and the rule would, in those cases, be abortive, the suggestion was referred to a special committee for consideration.

Concerning rules for aerial conductors, two definite suggestions were offered. One of these provided for a rule requiring conductors "attached to or in close proximity to buildings" not to be installed "so as to interfere with the work of the fire department;" the other for a rule prohibiting the placing of telegraph, telephone and similar wires on the same poles with electric light or power wires, and the stringing of such wires so as to pass above or below heavy current wires except where accidental contact is prevented by means of suspension or screening wires, as already provided in the Code. These suggestions upon vote were rejected.

The rule regarding the entrance of low-potential circuits into buildings was amended to allow such service wires to be brought in through a single iron conduit, the outer end of which must be carried downward and sealed to prevent the entrance of moisture. The outer end must also be kept at least 12 in. from frame buildings or frame portions of other buildings.

The rule on wooden molding was amended to specify a tongue not less than ½ in. thick between the conductors, and exterior walls not less than ⅜ in. thick under the grooves and ¼ in. thick at the sides.

The following are among the minor changes adopted:

Lightning arresters must be of approved construction. Transformers must not be mounted on frame buildings or frame portions of other buildings. Double-throw knife switches may be mounted to throw either horizontally or vertically, as preferred. Wires run in unfinished attics are to be classed as "concealed" and those run near water tanks or pipes are to be considered as exposed to moisture. Wires in attics, excepting in large churches or similar buildings, must be run between or through the joists and not on top of them. On switchboards spacings approved for 250 volts direct current are also approved for 500 volts alternating (instead of 440, as before). The rule on arc lamp hanger boards is restricted to series arc lamps.

Recent Electrochemical Developments.

ELECTRIC FURNACE CONSTRUCTION.

An interesting example of the introduction of electrochemical methods into old industries is offered in the manufacture of pure artificial corundum. The Norton Emery Wheel Company, an old established firm, with its main works at Worcester, Mass., purchased several years ago, from the Ampere Electrochemical Company, the patent of C. B. Jacobs, for fusing bauxite in an electric furnace, thereby producing a pure artificial corundum. The fused charge is allowed to cool slowly, when it acquires the hardness of corundum and the toughness of emery, and is suitable for wheels, stones and all the various uses of an abrasive. The process is worked in a plant of the Norton Emery Wheel Company at Niagara Falls. A rather extended and interesting exhibit at the St. Louis Exposition showed that the process is in a state of very healthy development.

A patent granted on November 22 to A. C. Higgins, general manager of the Norton Emery Wheel Company, is evidently intended for the special purpose of making artificial corundum, or as it is called, alundum; but is of more general interest since it shows how, by judicious furnace design, any special refractory lining with its troubles may be avoided. His furnace consists essentially of an iron shell forming the outside of the crucible with suitable means for applying water on the outside of the shell to all its parts in a continuously flowing stream or blanket, and conducting it away at the base. The portion of the charge in immediate contact with the cool shell solidifies and thus forms a lining for the rest of the molten mass. The lining consists, therefore, of solid alundum. Similar linings have been used with success in other electric furnace industries.

ELECTROLYTIC PROCESSES.

In a patent granted on November 22 to H. R. Cassel, a process is described of dissolving and extracting precious metals from refractory ores without preliminary roasting. The essential features are the electrolyte consisting of an aqueous solution of sodium chloride to which is added sodium bromide and potassium cyanide, and the use of a high current density, about 40 amp. per square foot of anode surface. The effect of the current is to produce at the anode a powerful solvent for gold with the resulting formation of a soluble cyanide for gold. It is said that during the process cyanide alone suffers any appreciable decomposition, so that the solution can be used again when a sufficient quantity of cyanide is added to it.

F. Jahn in a patent granted on November 22 produces barium hydrate by electrolysis of barium sulphide in a diaphragm cell, with anode plates about four times as large as the cathode surface.

A patent, granted to A. Brichaux on November 8, refers to the construction of a mercury cathode cell for the electrolysis of sodium chloride. The principal aim in the design is to maintain two layers of unequal density in the electrolyte. For this purpose vertical partitions are provided in the cell, so that the lighter layer of liquid and the heavier layer are introduced into the cell and circulated through it separately. The lower layer in contact with the mercury is saturated with alkali chloride, while the upper, lighter layer contains a smaller amount. In this way the inventor tends to prevent any anodic chlorine from reaching the mercury cathode.

F. G. Briggs, in a patent granted on December 6, describes details of mechanical construction of electrodes and electrode connections for electrolytic cells.

DISCHARGES THROUGH GASES AND CATALYSIS.

That catalytic action may be made use of to good advantage in electrolytic processes was the leading idea of an interesting paper of W. Ostwald at the recent International Electrical Congress. H. Pauling, in a patent granted on December 6, describes a novel combination of catalytic action with brush discharges through gases. The object in this case is the production of ammonium formate from Dowson gas or a mixture of wafer gas and nitrogen. Brush discharges through the gas mixture alone do not result in the production of ammonium formate, but this substance is formed in the presence of porous contact substances like spongy platinum. This formation goes on to a slight extent as a contact process without any brush discharge, but the brush discharges are said to greatly increase the condensing action of the porous contact substances, so that the effect becomes sufficiently strong for practical application.

MISCELLANEOUS.

A patent granted on November 22 to H. Jone refers to details of construction of the apparatus used in his scheme of discharging a primary battery and regenerating the chemicals of the battery by the energy of burning fuel. The main points of his apparatus were described and discussed at great length in our issue of July 30, 1904, page 176.

Two patents granted on November 29 to A. Meygret refer to a protective coating or covering for storage battery plates to hold the active material on the grid against the effects of expansion and contraction.

P. Brandt, in a patent of November 22, describes details of construction of small galvanic elements for pocket lanterns and the like.

A patent granted to H. G. Pape on November 22 refers to a cord by which a small secondary battery, such as used for audiphone sets, may be connected to an incandescent lamp socket for charging.

E. P. Weggen patents details of construction of an electric heater for special use in the boot, shoe and leather working trades. A rheostat is dispensed with since the resistance coil serves the joint purpose of raising the temperature and of regulating the current, the wiring being such that the length of the resistance wire thrown into the active circuit is adjustable within certain limits.

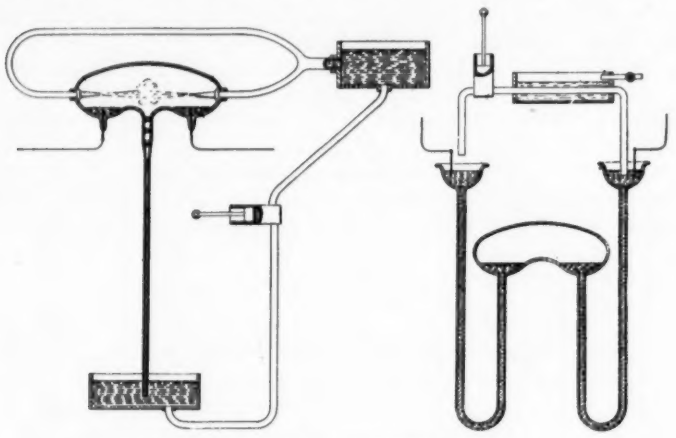
Wireless for Coastwise Steamships.

The Mallory Steamship Line will equip its vessels with wireless telegraphic apparatus. The steamship *Denver* is the first of the liners to be equipped. The De Forest system will be used, and as that company intends to establish many stations along the Atlantic and Gulf coasts, the result will be that the Mallory vessels will always be presumably in wireless range of land. The Mallory Line is the first of the coastwise companies to install the wireless system on its vessels.

Cooper Hewitt Converter.

Three patents were granted December 6 to Mr. Percy H. Thomas upon specific forms of the Cooper Hewitt converter or current rectifier. As will be recalled, the Cooper Hewitt converter is based upon the "electric valve" principle; a current passes through the converter in only one direction, an electrode resistance so great being opposed to flow in the opposite direction as practically to prohibit the passing of current of opposite sign. The object of the forms of rectifier illustrated are to provide means for conducting a large amount of current into and from the devices with relative small resistance, to provide means for keeping the device cool and to withdraw from the chamber any excess vapor and maintaining the vapor in proper condition.

Referring to Fig. 1, the enclosing chamber shown at the top is provided with two side tubular extensions containing columns of



FIGS. 1 AND 2.—CONVERTER.

mercury which constitute respectively the positive and negative terminals of the device. The lower ends of the tubes are open and are submerged in vessels containing mercury. The chamber is provided with a third tube in the middle which terminates in a vessel also containing mercury; this vessel is connected by a pipe with a pump, the outlet of which is connected by a pipe with the bottom of one of the electrode vessels. In operation current is led into, say, the left-hand electrode vessel, then passes up the mercury column in the tube leading therefrom; then through the vapor in the upper chamber, and thence down through the right-hand column and to line by way of the circuit conductor.

As more or less heat will be developed in the passage of the current, a more or less continuous flow of mercury is kept up through

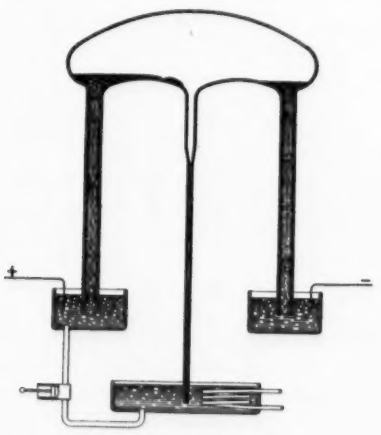


FIG. 3.—CONVERTER.

the left-hand tube into the chamber, whence it flows downward through the center tube carrying with it more or less of the gas or vapor contained within the chamber. This continuous flow of mercury will not only result in providing cool mercury for the positive terminal of the device, but will continually act as a pump for maintaining the requisite purity with respect to the vapor in the chamber. The receptacle beneath the center tube may be constructed to afford a considerable heat radiating surface and there may be added a cooling pipe, as shown, for circulating water or other cooling fluid. It is generally not found necessary to cool the negative terminal, as in some instances the device operates better while this terminal is hot. There will always be more or less condensation of the mercury vapor upon the walls of the vapor chamber, and the presence of the cold body of mercury contributes to this action, which results in keeping the vapor at its proper density.

Fig. 2 shows another arrangement wherein the lead wires are connected directly with the positive and negative terminals and mercury from a receiver is forced through pipes into the chamber in the form of a finely divided spray. By this means both the terminals and the conducting vapor within the chamber are cooled. Fig. 3 is an arrangement for use when it is desired to maintain the conducting gas or vapor in the container at a high pressure, in which case atmospheric pressure might be insufficient for the purpose. The pressure within the container corresponds to the height above the level therein of the mercury in the tubes shown. In this case a water jacket for cooling the mercury is shown around the pipe connected with the pumping arrangement.

New Telephone Patents.

WIRELESS TELEPHONE.

Under the title wireless telephone, R. L. De Moura, of New York, has obtained a patent for a rather complex form of radiophone. The receiving of the apparatus depends upon the well-known principle of the selenium cell. This the inventor claims changes its resistance far more nearly in proportion to the light falling upon it, if this light be wholly violet and ultra-violet. The transmitting beam is to this end deprived of all save these rays. A quartz screen serves to sift out the lower frequency rays. Another device provided serves to render the beam of light parallel in all its rays. This consists of a deep grating, the cross bars of which are covered with lampblack. All rays parallel with these bars pass through. All others are absorbed by the lampblack. The patent also includes a calling device and means for rendering the receiving cells proof from surrounding and extraneous heat rays.

PARTY LINE SYSTEM.

George M. Crocket has invented a selective party line system which is quite novel. The selection depends upon putting upon the line wires a particular combination of direct and alternating current, which by affecting a controlling relay at each station serves to ring the desired station only. A series of relays, two at each station, serves to provide against interference or listening in upon connections, from non-wanted stations.

AUTOMATIC SERVICE REGISTER.

C. E. Scribner, of Chicago, has obtained a patent for an automatic call register which differentiates between calls to and calls from a station. Mr. Scribner locates his register at the subscriber's premises and he places his counting train under the combined control of two electromagnets. One of these is polarized and by reversing the relative direction of the battery current for the answering and calling plugs of all cord pairs, this actuating magnet is made to respond to the connection of the answering plug to the line and to refuse response to the calling plug. There is, however, another current to be considered. This is the alternating calling current. This would register one count for each alternation of potential, unless means were provided to prevent. This means consists of two features. One is the provision of a blocking magnet which controls a lock on the counting magnet armature. The second is the reducing to a minimum the effect upon the actuating magnet of a rapidly varying current, by enclosing the magnet coils in heavy copper sheaths. These sheaths so absorb the energy of the varying current that the resulting pull is insufficient to overcome the blocking stop. With steady current on the other hand the pull is sufficient to push the blocking stop out of the way. The Western Electric Company has been assigned this patent.

TELEPHONE CIRCUIT SYSTEMS.

Two methods of connecting in line and supervisory signals have been patented by M. G. Kellogg, of Chicago, the patents being assigned to the Kellogg Switchboard & Supply Company. In one of these systems the drops are legged off one side of the line to ground, while the clearing-out drop is bridged. The hand generator is bridged and in addition one side is grounded. When a cell is sent

in, all the current from the generator acts upon the line drop through ground and throws it. When the cords are up and disconnection is desired, the clearing-out drop, which is low wound, so far shunts the line signals that they do not get sufficient current to operate them. This system also includes a busy test, which provides a hum instead of a click, as indication to the operator that a line is busy. The act of testing a busy line cuts in a vibrator, which inductively produces the hum in the operator's telephone.

The second system of Kellogg includes automatic clearing-out signals. The receiver hook in its depressed position grounds one side of the line, at the subscriber's instrument, while from the other side of the line, the line drop is legged to ground. A hand generator serves to throw the line drop. When the operator answers she uses a pass of cords, from one side of which a drop and battery in series is legged to ground. The particular side of the line is that which is normally grounded at the sub-station. Thus when the receiver is returned to the hook the circuit of this drop is completed to ground and the resulting current from the battery operates the drop. As soon as the cords are disconnected, the drop and battery are obviously disconnected with them.

A third system is that of W. C. Runge, of London, England. In this system full supervisory signals are provided and all control is worked out from a momentary ground, which is connected as the hook is passing from its depressed to its elevated position, or vise versa. While clever in its conception, this system seems too complex to compete with the present standard systems.

BLOCKING DEVICE FOR A DESK STAND HOOK SWITCH.

Probably every one who has had occasion to use a head receiver in connection with an ordinary telephone set has been puzzled as to what means to employ to hold down the switch hook when the telephone is not in use. One way of accomplishing it which is frequently employed is to have a detached band telephone provided for use as a weight. Another old standby in the shape of a weight

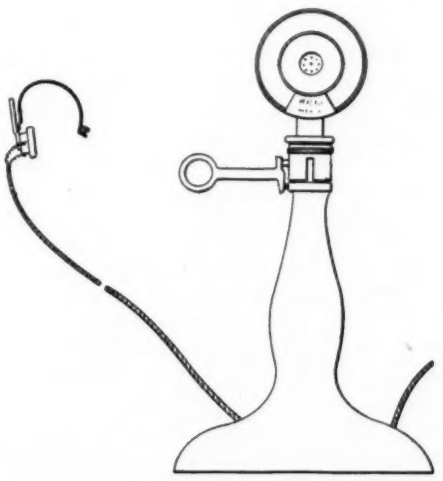


FIG. 1.—BRINCKLE BLOCKING DEVICE.

is a Fuller battery zinc. For desk stand sets a much more convenient means appeared some time ago, when the introduction of the common battery system led to the adoption of a new form of desk stand. This stand has a metal shield mounted to protect the springs, and in order that the switch lever may affect them an open slot is left in the shield.

As long as the slot is in line with the switch arm, this latter can rise. If, however, the normal clamping screw be removed and the slot is rotated out of normal alignment, as shown in Fig. 1, the hook lever cannot affect the springs. Mr. A. L. Brinckle, of Philadelphia, has obtained a patent for the use of the protecting hoop in this way, but undoubtedly many who have been using it for some time will question his priority of invention.

A NOVEL TRUNK CIRCUIT.

For trunks on the calling circuit basis, the use of the "busy back" hum or signal is now familiar to all. Mr. E. H. Smythe, of Freeport, Ill., proposes to make it rather secondary in its significance, as with a trunk circuit he has invented it is proposed to connect a trunk assigned with a desired line, whether it is busy or not. If the line is busy the trunk circuit will be cut, so that there is no disturbance of the existing connection, and the busy back will be put on to so indicate. As soon, however, as the first connection is cleared the hum will be removed, the trunk connected through and the calling operator will be signaled. The Western Electric Company has obtained the patent for this circuit by assignment.

PARTY LINE RINGING KEY.

With selective ringing systems it has been customary to provide one ringing key for each different type of current, the circuits being connected through these keys in series, each key having necessarily the usual cut-off features. With such keys one must talk through two contacts for each key of the set, a decided disadvantage. To overcome this F. R. McBerty has devised and patented the key shown in principle in Fig. 2. It will be noted that one pair of cut-off con-

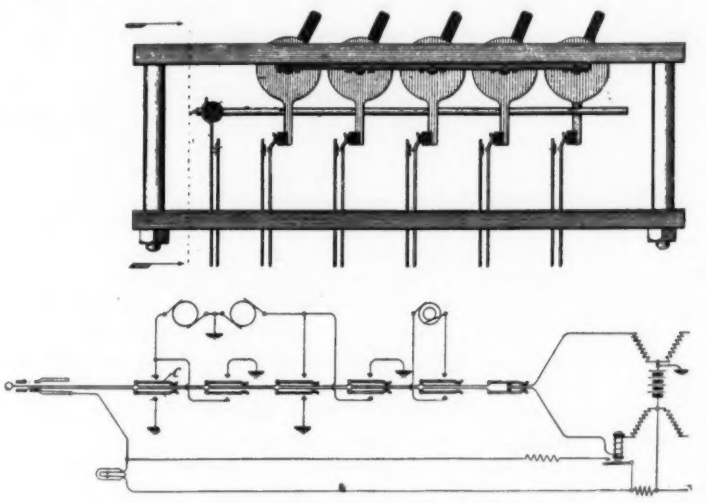


FIG. 2.—M'BERTY SWITCH KEY.

tacts serves for all the different ringing elements, this cut-off key being controlled by a master bar. The Western Electric Company has obtained this patent also.

ANTISEPTIC DEVICE.

An antiseptic device for telephones of the hand-microphone type has been patented by S. Churchill-Otten, of Australia. A strip of paper is drawn from a roll across the transmitter mouthpiece and is held by a clamping device integral with the roll holder. The novelty is in the adaptation to the hand-microphone.

Pumping in Irrigation Work.

Some interesting engineering data are given in a paper by Mr. J. J. Brown on turbine pumps for irrigation and drainage read before the recent National Irrigation Congress, which was held at El Paso, Tex. With regard to Hawaii he said: "In the Hawaiian Islands irrigation has developed a great deal of land that was arid and unproductive, sugar cane being the most extensive crop. Over 2,000 tons of sugar were produced on this land last year, netting the growers $14,000,000. Both gravity and pumping systems are used in the Hawaiian Islands, the latter being necessary in most localities. In the Island of Oahu, which is 12 miles wide and 35 miles long, about 300,000,000 gallons of water are pumped each day from wells reaching a stratum 400 to 800 ft. below sea level. In other islands the water is taken from sumps excavated 5 to 8 ft. below sea level. The pumping plants are usually fed from 12-in. wells 50 ft. apart, each well pumping 1,000,000 gallons, ten operating continually and two being held in reserve. The highest head pumped against is 450 ft. In Waianae a waterfall in the mountains supplies electric power, which is used in pumping near the sea level, directly-connected pumps being used to lift water 15 ft. In Maui the pump capacity is 140,000,000 gallons daily; in Kauai 55,000,000 gallons daily, and in Hawaii 7,000,000 gallons. The majority of the pumps have been installed for some time and are of the reciprocating type, but the new installations are entirely high-speed centrifugal pumps. In several cases shafts have been sunk 200 to 300 ft. to the water level and directly-connected pumps with long vertical shafts reaching to motors at the surface have been installed."

Preparations for the Colorado Lighting Convention.

The convention of the National Electric Light Association, which will be held in June in Colorado, will be well entertained. Committees have begun their work, and the delegates will be given the best of everything. The convention proper will be held in Denver, and the entire party of delegates will then be taken to Colorado Springs. When it was decided to hold the convention in the West, the president of the association, Mr. Ernest H. Davis, made a trip to Colorado to learn just where the meetings should be held. It was decided finally to let the central station men of Colorado and adjoining States have a voice in making the decision. A meeting was called and it was determined to hold the business sessions in Denver and to take the convention to Colorado Springs for two or three days.

Mr. Davis returned to the East and selected Harry L. Doherty, president of the Denver Gas & Electric Company, as the representative of the National Association in the West, to arrange for the convention. Mr. Doherty immediately invited central station men, business men and railroad men to assist him in the work. More than 100 of these men attended a meeting held in Denver and scores of others wrote pledging their support.

Following is the membership of the general committee: Orson Adams, Grand Junction Electric & Gas Company, Grand Junction, Colo.; William Mayher, Greeley Power & Light Company, Greeley, Colo.; W. E. Renshaw, Seaton Mt. Electric Light, Heat & Power Company, Idaho Springs, Colo.; F. E. Webber, Leadville Gas & Electric Company, Leadville, Colo.; P. N. Munn, Telluride Power Company, Telluride, Colo.; R. S. Campbell, Utah Light & Railway Company, Salt Lake City, Utah; John Martin, California Gas & Electric Company, San Francisco; A. Pollock, San Francisco Gas & Electric Company; F. E. Warren, Cheyenne Fuel & Power Company; C. F. Brown, Roaring Fork Electric Light & Power Company, Aspen, Colo.; William T. Wallace, Colorado Electric Power Company, Canon City, Colo.; Herman Webber, La Bella Electric Company, Cripple Creek, Colo.; C. H. Peters, Durango Light & Power Company, Durango, Colo.; George B. Tripp, Colorado Springs Electric Company, Colorado Springs, Colo.; Charles Neely, Fremont Electric Light Company, Florence, Colo.; M. T. Morrill, electric light company, Golden, Colo.; F. P. Dewey, electric light company, Georgetown, Colo.; Gen. Fred Walsen, electric light company, Idaho Springs, Colo.; H. R. Wray, Chamber of Commerce, Colorado Springs, Colo.; J. F. Vaile, electric light company, Pueblo, Colo.; E. J. Temple, electric light company, Boulder, Colo.; D. O. Freyberger, electric light company, Loveland, Colo.; John Doss, electric light company, Ouray, Colo.; C. Y. Breck, Telluride Electric Light & Power Company, Telluride, Colo.; Nelson Rhoades, Arapahoe Electric Light & Power Company, Littleton, Colo.; W. F. Jones, Gold Belt Consolidated Electric Company, Victor, Colo.; J. B. Wiggenhorn, Florence & Cripple Creek Railroad Company, Cripple Creek, Colo.; G. E. Sethman, Meeker Light, Heat & Power Company; C. W. Badgley, Crested Butte Light & Water Company; Gen. Irving Hale, General Electric Company; O. B. Kohl, Lacombe Electric Company; John Brannean, Lacombe Electric Company; J. H. Waters, La Bella Electric Company; S. W. Cantrill, Denver Tramway Company; J. A. Beeler, Denver Tramway Company; T. B. Stearns, Stearns-Rogers Manufacturing Company; Major S. K. Hooper, Denver & Rio Grande Railway; J. F. Vallery, Burlington Route; W. E. Bridgman, the H. J. Mayham Investment Company; E. R. Griffin, Union Pacific Railroad; C. L. Wellington, Colorado & Southern Railroad; D. H. Hoops, Chicago & Northwestern Railroad; G. W. Vallery, Colorado Midland Railway; H. B. Kooser, Missouri Pacific Railway; W. J. Jones, Denver, Northwestern & Pacific Railway; Charles B. Sloat, Rock Island Railway; J. P. Hall, Santa Fé Railroad; D. C. MacWatters, Cripple Creek Short Line; Fred H. Bostwick, Hendrie & Bolthoff; J. C. Poole, Stanley Electric Company; H. L. Woolfenden, Gilbert Wilkes & Co.; R. D. Marthens, Nernst Lamp Company; Mayor R. W. Speer, E. S. Kassler, Montrose Electric Light & Power Company; J. J. Cooper and J. W. Stearns, Mountain Electric Company; Edward C. Means, Adams-Bagnall Electric Company; Edward Pool, American Steel & Wire Company; J. D. Jackson, Western Electric Company; W. P. Carstarphen, Carstarphen Electric Company; H. W. Lawrence, New England Electric Company; P. J. Brown, General Electric Company; R. E. Miller, Crocker-Wheeler Company; Charles S. Onderdonk, Onderdonk Manufacturing Company; R. B. Sullivan, Frank W. Frueauff, Henry L. Doherty, C. W. Humphrey, W. J. Barker, E. Y. Sayer, C. N. Stannard, Rufe Gentry, John Craig Hammond, J. Charles Andrews, Denver Gas & Electric Company; William Maher, Albany Hotel; A. R. Hall, Capital Lamp Company; C. H. Speers, Colorado Midland Railroad; J. F. Callbreath, J. S. Temple and Arthur Williams, Chamber of Commerce; J. J. Hernan and N. M. Tabor, Hotel Men's Association; Armour C. Anderson and John McNamara, Real Estate Exchange; J. J. Joslin, George Gano, Merchants' Protective Association; W. S. Iliff, C. K. Durbin, G. W. Cook, James Williams, Thomas Smith, J. J. Henry, B. K. Sweeney, all of Denver.

Following are the committees as announced by the three men chosen to select members:

Executive—Henry L. Doherty, chairman; F. W. Frueauff, vice-chairman; G. B. Tripp, H. R. Wray, J. A. Beeler, T. B. Stearns, J. F. Callbreath, Armour C. Anderson, Gen. Fred Walsen.

Transportation—George W. Cook, chairman; J. S. Temple, Major S. K. Hooper, J. F. Vallery, E. R. Griffin, H. R. Wray, C. L. Wellington, George F. Porter.

Finance—George W. Gano, chairman; George B. Tripp, vice-chairman; Gen. Irving Hale, J. W. Stearns, C. K. Durbin, J. A. Beeler, J. J. Hernan, J. F. Callbreath, Armour C. Anderson, Gen. Fred Walsen, John Craig Hammond, G. W. Cook, J. H. Waters.

Entertainment—Philip Cross, chairman; F. W. Frueauff, W. E. Bridgman, T. B. Stearns, G. W. Vallery, G. B. Tripp, H. R. Wray, R. W. Speer, Gen. Fred Walsen.

Hotel—W. J. Barker, chairman; J. J. Hernan, J. J. Cooper, J. F. Vaile, S. W. Cantrill, H. L. Woolfenden, Philip Cross.

Advertising—John Craig Hammond, chairman; John McNamara, T. E. Fisher, S. K. Hooper, J. F. Vallery, N. M. Tabor, D. H. Hoops, J. J. Joslin, D. C. MacWatters, Charles B. Sloat.

Colorado Springs—George B. Tripp and H. R. Wray.

J. Charles Andrews is secretary of all committees. His address is The Denver Gas & Electric Company, 405 Seventeenth Street, Denver.

Newspaper Science.

We reprint the following from the New York *Journal*, where it appeared as an editorial with the head, "The Human Body is an Electrical Machine. This Fact Was Set Forth a Long Time Ago. Now Scientists Are Proving It." The peculiar paragraphing and changes of font are not reproduced.

"Those who have been readers of the Hearst newspapers for a long time are familiar with the theory of human energy, which we have advanced at various times during the past seven years. In impressing on our readers the importance of fresh air, deep breathing and a healthy blood supply, we have undertaken to show that our force comes not from the food that we eat, but from the electricity taken into the system through the lungs.

"The food that we eat is simply intended in adult life to replace worn-out material. It is like grease on the axles, paint on the wagon, new bolts or planks, as they are required. Our food simply replaces the worn-out parts of our body. The work that our body does comes into the body through the lungs and is taken up by the blood. We know how the doctors give iron to sickly children and women. Those that are intelligent among them recommend pure red wine as a stimulant because the crushed skin of the grape contains iron, easily assimilated by the system. But even the intelligent doctors don't know why they give their patients iron. It is the iron in the red corpuscles of the blood that takes up the electricity of the air as the blood passes through the lungs. This discovery and many others more important were made and announced many years ago by the late Albert Brisbane, talking to a people that could not understand him.

"The blood, charged with vital electric forces, carries those forces to all parts of the body. And when special efficiency and power are required in any part of the system, the blood with its electric energies is concentrated there by a wonderful automatic, concerted action of the mind and nerves. You know how the blood rushes to the head in deep thought, and to the stomach during the process of digestion. The brain and stomach both suffer if required to work simultaneously, and both do their work badly, because each requires the body's full electric energy.

"The scientific gentlemen, rather late in the day, are beginning to realize the importance of understanding the human body. Read the following statement concerning the investigations of Dr. Atkins,

who probably believes his 'discoveries' to be quite original. We present the condensation of a scientific article:

"'That life—at any rate, human life—cannot exist without electricity seems to have been demonstrated successfully by Dr. Albert J. Atkins, a member of the staff of the California Medical College. For a long time he has been devoting himself to the investigation of the electrical phenomena of the human body, and he says that each organ has an electrical action of its own. By a series of experiments he has now established that the center of electrical activity is in the air chambers of the lungs. He now announces that by mechanical means he has succeeded in registering a positive and a negative electrical current in the air chambers of the lungs of a living person outside the blood stream. Dr. Atkins expects to ascertain hitherto unknown facts about the relation of electricity to the problem of life, and scientists who have watched his work believe it will be of very great benefit in the electric treatment of diseases which have been unsuccessfully treated by medicine and surgery.'

"When Dr. Atkins and others shall have progressed a little farther in their investigations they will learn that it is not the crude electric power of the trolley wire that is at work in the human body. As the stomach absorbs and modifies the material world in its processes, so the lungs and the blood absorb and modify the electrical force upon which we live. Over the door of the great Greek temple they wrote, before modern science was born, 'Know Thyself.' Humanity is still struggling vainly, and with feeble success, to take that advice and to know itself. If human beings will understand that their vital force is absorbed through the nostrils and the lungs, and not through the gullet, they will have advanced somewhat on the road to self-knowledge. If they will understand that the magnificent winds that sweep across the earth contain our vital force, that the force is not found in mince pie or mush or in the flesh of animals, they will have progressed on the road to knowledge. If they will look intelligently at the pig, goffling down indiscriminate masses of food, heavy, stupid, filthy and vile, and then at the beautiful deer, swift, with large nostrils, living upon the twigs of trees and the clean air, they will learn something about a sensible life.

"Man, destined to direct and cultivate the whole earth, is made up of all the material substances of the earth. All of the earth's products are made necessary to him in order that he may be compelled to develop them. But these material substances simply build up the material body in infancy and make up for waste in maturity. The vital forces are electric; they have nothing to do with the stomach. No better proof of this could be demanded than the miserable, fattened, useless creature, with stomach overworked and lungs neglected. The man who breathes a great deal of fresh air, taking as little food as may suffice him, is as far above the other kind of man as the eagle is above the worm that eats its way through the earth."

Annual Meeting of the New York Electrical Trades Society.

The New York Electrical Trades Society held its annual meeting at the Hotel Astor on December 13 at 6 p.m. This was the ninth annual meeting, but marked the end of the tenth year during which this useful body for the interchange of credit information has been in existence. Starting originally with twelve members, it now has 77, and in the six kindred associations of this country there are no fewer than 300 companies and firms in full membership. This work is found inestimable in trade protection and in promoting the welfare of electrical commerce. Mr. A. P. Eckert, the efficient secretary and treasurer, made his annual report and showed the society to be in excellent condition, doing its work at a minimum percentage of cost. A number of active members of the board who have been energetic in its behalf for years past felt that the time had come for them to be let out to pasture, and Messrs. Reed, Marshall and Gallaher retired, therefore, from the directorate. A hearty and well-deserved vote of thanks was accorded these gentlemen for their constructive and conservative work during past years.

The new board of the society elected during the evening is made up as follows: President, John H. Dale; vice-president, H. R. Swartz, Sprague Electric Company. Directors—G. E. Pingree, assistant treasurer, Western Electric Company; B. H. Ellis, assistant treasurer, Manhattan Electrical Supply Company; R. B. Corey, manufacturers' agent; A. S. De Veau, manufacturer of telephones; C. C. Sibley, Sibley & Pitman. A great deal of satisfaction was expressed among the members at the strength and character of the new management, which, it is felt, will carry on the affairs of the society with loyalty and sustained efficiency.

The business meeting, which was well attended, was followed by dinner in the college room, to which a number of members and friends sat down, the guests including Mr. F. P. Vose, secretary of the National Electrical Trades Association; Mr. C. E. Trump, president of the Philadelphia Society, and Mr. C. N. Wilkins, delegate from Philadelphia to the national body. Mr. H. A. Reed presided admirably and during the evening speeches were made also by Messrs. Vose, Dale, Trump and C. P. Scott. The remarks of Mr. Vose were more in the nature of an address on the subject of credit relations and presented very clearly and succinctly a number of points of view embodied in the decisions of the courts or arrived at through the experience of individuals and commercial organizations. This address, it is understood, will be printed and distributed. The dinner, which was preceded by some very good music by a negro quartet, came to a close about midnight.

Fourth Annual Convention of the Interstate Independent Telephone Association.

(*By Telegraph.*)

In accordance with the programme already announced, the first session of the fourth annual convention of the Interstate Independent Telephone Association was called to order by President Barnhart on December 13 in the banquet hall of the Auditorium Hotel, Chicago, and there was a large attendance which increased during the day. Before the regular programme of business was taken up, credentials and certificates of right of admission were called for. It was decided to allow all persons interested to attend the open meetings of the association, but executive sessions were closed to all except authorized holders of credentials.

President Barnhart then made his annual address in which he said that since the organization had been formed self-confidence had been strengthened among independent telephonists. The independent movement had grown all over the country in every town, as well as in great cities like Chicago, which, however, like other large exchanges, was more or less isolated from other independent lines. He pointed out that freedom of discussion and consistency of action during the convention would be potent forces in assisting the work of independent telephone operators. The programme had been arranged so that ample time could be given to the examination of the apparatus and supplies exhibited, as well as in making valuable acquaintances.

Secretary Coleman, in his report, said that certain manufacturers had been attempting to break up the association during the past year and that a remarkable state of affairs had developed, nothing less than a boycott having been attempted regarding exhibits at the annual gathering. The importance of getting closer together had been fully discussed from time to time, but something must now be done of a definite character.

President Barnhart then called for reports of committees. The first report was that of the Express Committee, of which George N. Bandy, of Des Moines, Iowa, was chairman. He stated that he had not prepared a report or paper, partly because inquiry had developed the fact that in most cases express companies were now paying for their telephone service, and hence the injustice under which independent companies have suffered has to some extent been removed.

The minutes of the conference of representatives of the Interstate Independent Telephone Association and of the National Association were then read. These representatives consisted of J. B. Hoge, J. G. Splane and E. L. Barber, for the National Association, and E. M. Coleman, C. E. Hall and H. A. Barnhart for the Interstate Association, which met at the Auditorium on November 13 with the specific purpose of discussing plans by which the two bodies could be effectively consolidated. It was then agreed that at the annual convention of the Interstate Association the appointment of five members should be asked for to meet in further joint conference five representatives of the National Association, and that these ten representatives be empowered to effect a permanent organization by union and consolidation of the two bodies.

Secretary Coleman then read the invitation of the American Steel & Wire Company to visit the wire mills at Waukegan on Thursday

morning. After the invitation had been unanimously accepted for this interesting trip, the meeting was adjourned until 4 p.m., when the convention went into executive session.

Senator Hull offered a resolution with regard to the subject of the proposed consolidation and the consideration of ways and means, and with the provision that the ownership of the Interstate Association be continued in the consolidated association. After considerable discussion it was decided that the committee for the Interstate body consist of the past-president, the incoming president, secretary and two other members. The meeting was then adjourned until Wednesday afternoon.

Apparently there is a defined understanding among most of the telephone manufacturers not to exhibit at this convention because of general disapproval of the association policy in several matters, notably in raising the dues of the associate members of the manufacturing class; the attitude of the independent companies toward standardization, and the establishment of a co-operative supply house, which is considered not only a bad business policy for the independent operators, but inimical alike to the best interests of the art and to the welfare of the manufacturers themselves, who have sustained all the burden of the rapid and radical improvements that have been made in telephony during the past five years.

The second meeting of the convention was called at 2.40 on Wednesday afternoon. President Barnhart announced that Mr. O. M. Bake, vice-president of the Miami National Bank, of Hamilton, Ohio, who had been down on the programme to read a paper discussing the reasons why independent telephone securities did not command the market price to which they were entitled on their earnings capacity, had been too ill to prepare this important paper and was not able to be present. Mr. Theo. Thorward, of South Bend, Ind., president of the Indiana Independent Telephone Association, then read a paper on what the independent telephone companies owe the public and vice versa what the public owes to the companies. He said he regarded the subject as of great importance to independent operators. At the beginning of the independent movement the people had the Bell monopoly on one side and the alternative of inferior service on the other. They had put up with poor service for a long time, but now people knew that the independents could give good service if the companies chose, and they demanded it. It was the duty of every local independent company to build out into the surrounding country so as to serve that territory. Thus the Automatic Company, of Chicago, if it was independent, owed it to the community to allow surrounding independent lines to connect with it. The public owed the independent telephone operators hearty support, should pay fair rates, and should pay telephone bills promptly. At the conclusion of this paper President Barnhart urged a free discussion of the points raised. Mr. Conklin, of Aurora, Ill., said he had offered, if President Wheeler, of the Automatic Company, of Chicago, would get the permit, to build a conduit line from the tunnel of the Automatic Company to the city limits, so as to enable the Aurora lines to connect with those in Chicago. President Wheeler had said that he could not then get his directors together to consider the proposition. Mr. Thorward said, so far as Indiana was concerned, that if Chicago was willing to connect up there was $100,000 ready to build the line to South Bend. Mr. R. M. Richardson, of Evansville, Ia., wanted to know if it was considered advisable to connect up with the Bell system for toll line service. Mr. George H. Black insisted that this should not be done, and held that by remaining independent they would stimulate capital and encourage the construction of independent toll lines. Mr. B. F. Wasson, of Illinois, regretted that Mr. Bake's paper had not been presented. He said that the best way to get money for independent telephone work was to get the home people interested. Chicago capitalists did not yet know the value of independent telephone securities. He himself had never had any trouble in getting money for such enterprises from his home people.

An intermission of five minutes was then taken, when the delegates went through the usual infliction of having their photograph taken in a group. Mr. E. D. Graham, president of the Mexico Telephone Company, of Mexico, Mo., then read a paper on "Manufacturers' Duties and Their Dues." The gist of his paper was that if their opponents obtained control of the telephone factories, the independent operators would suffer, and being without access to proper apparatus they would find it impossible to advance or to give good service. It was the duty of manufacturers to protect their patrons rather than to organize selfishly with a view to their own assumed or apparent interests.

Mr. H. C. Barbour made a motion which was carried that a committee be appointed to wait on the Automatic Telephone Company, of Chicago, and ascertain what were the real probabilities of the independents outside of Chicago securing connections with its system inside that city. Messrs. Barbour, Thorward and A. James Vernier were appointed on this committee.

A paper by Mr. J. H. James, of Mankato, Minn., president of the Minnesota Independent Telephone Association, on the imperative necessity for uniformity of equipment and the standardization of apparatus, was then read by Mr. Jones, of Arkansas. This paper urged strongly the vital necessity for standardization and uniformity of apparatus and construction, so that the independent service and system could be brought up to a higher plane of efficiency. The paper contended that the problem must be met face to face and that the time had arrived to deal with it. In the discussion Mr. Barbour was curious to know where the proposed standardization should stop. Admitting that standardization was in many respects a good thing, he held that when pushed too far it meant death to improvement. Mr. Thomson said that even if standards were prescribed, the best instruments would, nevertheless, be purchased by the customer in the open market. As long as there were improvements it was impossible to standardize closely. The meeting then adjourned at 5 p.m. to meet again at 9 on Thursday morning.

The programme as laid out for Thursday, includes the following papers: One by E. H. Moulton, president of the Twin City Telephone Company, of Minneapolis, Minn., on the importance of bringing about uniform telephone rates and toll rates by legislation or otherwise, particularly in towns of the same size; Senator R. C. Stephenson, of Rochester, Ind., on how to avoid personal injury and responsibility in telephone construction work and maintenance; A. C. Davis, manager of the Parkersburg Telephone Company, of Parkersburg, W. Va., on the following series of enigmas: "Where are We? How Did We Get There? What of the Future?" When these riddles of the universe are disposed of in their particular application to independent telephony, Mr. P. C. Holdoegel, of Rockwell City, Iowa, will present a paper on the evils of connecting with the Bell system and the advantages of pushing forward the completion of the independent network. This programme will probably be carried out broadly, subject to the chapter of accidents. On Thursday afternoon the delegates will relax and spend time in visiting all the exhibits they can locate, while the officers and executive board will take charge of the entertainment of all in attendance. The evening is to be devoted to a banquet, concert and vaudeville.

CURRENT NEWS AND NOTES.

ELECTION RETURNS IN HAWAII during the recent Presidential campaign were distributed through the islands largely by means of wireless telegraphy.

GERMAN TRACKLESS TROLLEYS.—A cable dispatch from Berlin of December 5 says: "The first trackless trolley street railway has begun operation in Berlin, and is apparently a success.

THE HUMMING OF AERIAL WIRES.—Herr Bock, of Babenhausen, Germany, has been carrying on observations of the humming, both of telegraph and telephone wires. The humming of wires running east and west is said to presage a fall of temperature, often ten or more hours in advance of the thermometer; the humming of wires north and south advises a rise in temperature, almost always several hours in advance of the thermometer.

CARNEGIE INSTITUTION WORK.—At the annual meeting in Washington, D. C., this week of the board of trustees of the Carnegie Institution announcement was made that during the year 114 grants, aggregating $355,070, had been made to further researches in the several branches of science, and $1,000 paid to each of twenty-four research assistants for specified scientific investigation. The larger projects undertaken by the Institute during the year include: The establishment of a department of experimental biology, with stations at Cold Spring Harbor, L. I., and at the Dry Tortugas, Fla.; of a department of economics and sociology; a bureau of historical research; a department of international researches in terrestrial magnetism.

THE NOBEL PRIZE.—The Nobel prize for physics has been awarded to Lord Rayleigh, professor of natural philosophy of the Royal Institution; for chemistry, to Sir William Ramsay, professor of chemistry of the University College, London, and for medicine, to Prof. Pavloff, of the Academy of Medicine of St. Petersburg.

A. I. E. E. MONTHLY MEETING.—The monthly meeting of the American Institute of Electrical Engineers will be held in the Chapter Room of Carnegie Hall, 154 West Fifty-seventh Street, New York, December 23, at 8.15 p.m. A paper on "The Maximum Distance to Which Power can be Economically Transmitted," will be presented by Ralph D. Mershon, member.

THAWING FROZEN PIPES.—The National Electric Light Association has just issued a report on thawing water pipes by electricity. This report is compiled by Mr. George S. Haley, of Rutland, Vt., and comprises data received from 75 different companies, which have already had experience in this direction. The report will be gladly welcomed by those members of the association located within the frost belt.

WORLD'S HYDRO-ELECTRICAL DEVELOPMENT.—Mr. George Johnston, of Ottawa, Ont., the Dominion statistician, says that the amount of water power, actually used for electrical production throughout the world at the present time, is over 2,000,000 hp. Of this amount Canada uses over one-tenth, or more, in fact, than any other country excepting the United States. He gives the figures for the United States at 527,467 hp, and for Canada at 228,225 hp hydraulic.

COLORADO N. E. L. A. CONVENTION.—At a meeting of the executive committee of the National Electric Light Association, held in New York, December 6, the dates fixed for the Denver-Colorado Springs convention were June 6, 7 and 8, at Denver, and 9, 10 and 11 at Colorado Springs. Mr. Henry L. Doherty has already organized a local executive committee in Denver to take up arrangements for the convention, with a number of special committees that are already at work. The far-Western meeting will not be allowed to suffer by comparison with any previous meeting, if prompt and energetic work can secure its success.

A NOVEL NIAGARA POWER SCHEME.—A Canadian correspondent refers to a unique scheme for power development along the Niagara frontier. It has for its foundation the turning back of the waters of the Chippewa River, making its present source its mouth, and its outlet into Lake Ontario instead of into the Niagara River, as nature has fixed it. Between the present headwaters of the Chippewa, but which would under the contemplated transformation become its mouth, and the headwaters of the stream which would carry their combined volume to Lake Ontario, is a width of several miles. This would have to be excavated, which those who are promoting the project hold would not be a task either difficult or expensive. They say in fact that their whole undertaking will be a comparatively easy one from an engineering standpoint. With the course of the Chippewa reversed, advantage can be taken for power purposes of the 300-ft. drop between the level of the Niagara River, above Niagara Falls, and the level of Lake Ontario.

PARIS AUTOMOBILE SHOW.—A cable dispatch from Paris of December 10 dwells on the magnitude of the present automobile show and its brilliant illumination. It says: "The exhibition in the Grand Palace, in the Champs Elysées, and in the Palace of the Cours La Reine, bordering the Seine, opened to-day by President Loubet and attended by the Ministers of Commerce and of Agriculture, is regarded as the apotheosis of automobile industry. Nothing like it has ever been seen in Paris before. Dozens of Greek pylons surround the palace like huge lighthouses, each surmounted by electric lights. The roofs of both palaces are outlined by rows of brilliant electric lights. In the interior of the Grand Palace 200 wires hang from the central point of the dome, stretching to the farthest corners of the cornices, each burning 1,000 electric lamps, giving the impression that the entire ceiling is one blazing sun. Each stand is arranged with elaborate motives in white, yellow, red and blue lights. All the great motor firms are vying with one another in this decorative competition, to the delight of the public. The splendor of the illumination and the lighting may be realized by the fact that the total number of separate electric lamps exceeds 900,000."

ELECTRICAL OSCILLATIONS OF DIFFERENT PHASES.—A patent issued November 29 to Prof. F. Braun relates to a method for producing quick currents with phase difference in an economical manner. The method, which is intended for use in wireless telegraphy, consists, essentially, in coupling those oscillating elements in which quick currents with phase difference are to be produced, with an exciting oscillating circuit, either inductively or directly with different strength, according to the degree of the required phase difference of the oscillations. When a system of high frequency is to be excited by oscillations of low frequency, there is employed a transmitter which is intended for producing quick oscillations of long duration in such a manner that when one aerial conductor has died away the other aerial conductor begins to swing in equal phase. The exciting circuit, with its large amount of energy excites an oscillating circuit with which it is conductively connected, while a second oscillating circuit which is inductively coupled wth the exciting circuit excites a third oscillating circuit, which latter is likewise conductively connected with the second oscillating crcuit. By suitably selecting the self-induction of the exciting circuit on the one hand and that of the connecting lines on the other hand, the energy of the oscillations produced in the exciter circuit can be made to exceed materially the amount of energy obtained in the case of a static charge of the circuit on the same spark length.

INDICATOR FOR ELECTRIC OSCILLATIONS.—Having abserved that when a strip of so-called "gilt paper" was laid under the terminals of a resonator coil, long lightning-like sparks of a greenish color were produced, and that the effects were materially strengthened when small sheets covered with a fluorescent substance were brought under the terminals of the resonator coil, and that the maximum radiation resulted when gold leaf was rubbed on the fluorescent sheet, Prof. Adolph Slaby was led to devise a wave length indicator which forms the subject of a patent issued November 29, 1904. Upon a glass tube is wound in a close spiral an insulated copper wire connected with a metal handle formed by a metal tube drawn over the glass tube. The upper end of the copper wire is connected with a sheet of paper coated on one side with barium platino-cyanide crystals, over which gold leaf is rubbed. When the copper wire coil is in resonance with a neighboring vibration system and oscillates in a wave of one-quarter the length of that of the primary system, while the end of the coil earthed by the hand of the person holding the rod forms the potential node, the upper end connected with the fluorescent sheet forms the point of greatest variation of potential and the fluorescent body becomes powerfully illuminated and easily visible in full daylight. In determining the wave length in an oscillating system, a tuning rod of metal is provided, which is connected to ground. The rod is moved along the coil until the fluorescent body is brightly illuminated. On the coil is arranged a scale which serves for observing the wave length at which resonance commences.

LETTER TO THE EDITORS.

Niagara Electrical Development.

To the Editors of Electrical World and Engineer:

SIRS:—The excellent series of articles which you are now printing on the present Niagara power situation illustrates in an interesting matter the course of electrical progress. We can all recall how grandiose seemed the project to develop 50,000 hp at Niagara, with an eventual development of 100,000 hp. At the time there was no visible market for the smaller output, and many were the doubtful shakes of the head at the commercial prospects of the scheme. We now learn that plants under construction will, before long, bring the total of Niagara electrical power up to 700,000 hp, with plans on foot for the future development of an additional 360,000 hp.

The success of the original Niagara project can be considered as the triumph of an idea, as well as the realization of a business scheme. Of a score of shrewd and conservative business men approached with projects of this character, it is only the twentieth man

in whom live interest will be awakened, and this not because he alone can grasp all the circumstances, but because he is a man to whom an idea appeals, who is in close touch with the modern spirit and ever ready to respond to its call. It is to this spirit that American electrical development owes so much. While it is true that those who have been in the forefront have profited financially in most cases, this does not detract from the great benefit they have conferred as agents of progress.

As in 1892, the matter of a market for all the Niagara power to be developed is in the future, and from one standpoint it is well that this is so, for the necessity of finding customers promises again to give a new impetus to electrical progress. As the electrochemical industry in this country owes its vast development to Niagara power, so we may expect similar effects to follow from the search of a market for the power now being developed. One outcome that seems obvious is the speedy replacement of lighting and power stations within a radius of 100 miles or more of Niagara by sub-stations taking power from the Falls. The conditions are ripe for the idea of central plants supplying current to large territories, each plant displacing scores and even hundreds of local generating stations. Niagara as the agent in this development from the force of necessity would establish the precedents and set the example for the country at large, thus again playing the rôle of a national factor.

BOSTON, MASS. CHARLES R. DOWNEY.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Carbon Brushes.—ORNSTEIN.—In an article on improvements in carbon making the author notices recent attempts to make brushes of a combination of copper and carbon. Seiffert surrounds a metallic network of copper with carbon. Germain does the same. Loewenthal coats carbon particles with copper (electrolytically or otherwise), and compresses these strongly, so that the grains form a compact mass without the use of any binding material, according to his claims. Ringsdorff compresses a mixture of powdered copper, carbon (graphite) and tar at a pressure of 500 kilos, in moulds which are completely closed, and then bakes them at a very high temperature. One such brush, which gave satisfactory results in practical work, was composed of 67 per cent. of Cu and 33 per cent. of C.—Lond. *Elec. Rev.*, November 25.

REFERENCES.

Magnet Coils.—LACROIX.—The author develops a simple formula which enables one to calculate the heat developed in a magnet coil with an accuracy sufficient for practice. One has to know the dimensions of the pole and of the windings, but does not need a sketch of the windings. The formula is claimed to be only approximate.—*Elek. Zeit.*, November 24.

Induction Motor.—REY.—A mathematical article giving a correction of a formula formerly developed by him for the non-symmetric attraction of the rotor in an induction motor.—*L'Eclairage Elec.*, November 12.

Series Alternating-Current Motor.—LATOUR.—A brief note on the theory of the compensated single-phase motor.—*L'Eclairage Elec.*, November 12.

LIGHTS AND LIGHTING.

Comparative Tests of Gas and Electric Lighting.—A note stating that at the Westminster electrical testing laboratories tests have been commenced to determine the relative photometrical efficiencies of gas burners and electric lamps. Besides these figures other exprimental data will also be collected, such as the quantity, calorific value and density of the gas consumed. The electric lamps under test include flame arcs, open arcs, enclosed arcs (the two latter will be tested with different kinds of carbons), miniature arc lamps, incandescent lamps, Nernst lamps and mercury vapor lamps. All the tests are to be conducted with and without the lamp globes. Among the gas lamps are those of the intensified gas type and of the self-intensifying pattern. A number of incandescent mantles of various makes are to be examined. Current for the electric lamps is derived from an accumulator battery, the voltage being finally adjusted by a rheostat. A photometer of the flicker type is to be used.—Lond. *Elec*. November 25.

British Central Station.—An illustrated description of the Radcliffe electricity works, which contain two 120-kw steam dynamos, giving 250 amp. at 480 volts. There is also a balancer consisting of two four-pole machines coupled together on one bedplate, each machine having an output of 50 amp. at 220 to 240 volts when running at a speed of 800 r.p.m.; also a motor-generator set which consists of two 16-kw dynamos and one motor, all mounted on one bedplate. This set may be used for supplying energy for the lighting supply, or for battery charging, being driven off the traction bus-bars. It is also available for energy supply to the carsheds at 550 volts—the dynamos acting as motors driven from the lighting bus-bars, and the motor acting as the dynamo. A battery of 250 cells is provided giving 40 amp. for 10 hours or 180 amp. for one hour.—Lond. *Elec. Rev.*,

REFERENCE.

Flame Arc Carbons.—ORNSTEIN.—A long summary of recent developments in the composition and preparation of carbons for flame arcs.—Lond. *Elec. Rev.*, November 25.

Arc Lamps.—ZEMNER.—An illustrated description of mechanical details of construction of the regulating mechanism of differential arc lamps.—*Zeit. f. Beleucht.*, November 10.

POWER.

Gas Turbine.—E. K. SCOTT.—An article on the coming of the gas turbine. When working on Carnot's cycle between 1,600° and 1,700° C., the greatest possible efficiency is 85 per cent., while a reciprocating gas engine working on the Otto cycle with compression to 60 pounds per sq. in., combustion at constant volume, and expansion to atmospheric pressure, gives at most only 37 per cent. An important point to note is that it is relatively more important to have the lower temperature low than to have the higher temperature high. Thus an ideal gas engine working on Carnot's cycle between the limits of temperature 2,000° C. and 300° C. absolute, will lose as much by an increase of 100° on the lower temperature as it will by a decrease of 500° C. from the higher temperature. This is good, because it is clearly much easier to build a turbine for a low temperature than for a high one, indeed it is doubtful whether turbines can be water-jacketed effectively to withstand an initial temperature of 2,000° C. Of course, in any form of motor using gas, a large amount of heat must necessarily be lost in the water, and the higher the initial temperature the greater will this amount be. It has been suggested to utilize this heat by raising the water to the boiling point and then passing the steam along with the gas through the turbine, but clearly a better way would be to utilize the steam in the gas producer, and thus dispense with separate boilers. In order to fully utilize the full velocity of the gas, some such arrangement of expansion in stages must be used as in the Curtis and other steam turbines. However much the steam turbine itself may be perfected, it will always be handicapped by the boiler side of the proposition. It is, however, not so much the steam turbine as the gas engine that the gas turbine will have eventually to reckon with. The author discusses several points of comparison between the gas engine and the gas turbine. This comparison apparently favors the turbine.—Lond. *Elec. Rev.*, November 25.

Gas Engines for Central Stations.—CAMPBELL.—An article giving some exact data on the results obtained with gas engines in central stations. He deals especially with the results obtained by the Guernsey Electricity Company where existed prior to the installation of gas engines a steam-driven plant of practically the same output as

the gas engine plant which was installed later. The comparison of the working costs of the steam and gas engine stations at Guernsey afford, in the opinion of the author, a good guide and a fair comparison of the relative merits of the two powers—steam and gas—since the stations are equally favorably situated with regard to the coalfield, and the cost of carriage on the coal is the same. The plant at the St. Peterport steam-driven station consisted of one battery (capacity 32 kw for 10 hours), two 75-kw combined steam engine sets, two 180-kw, triple-expansion steam engine sets, one condenser, 360 kw capacity, two water-tube boilers and superheater for 75 kw each, two water-tube boilers and superheater for 180 kw each, one Green's economizer and two Weir pumps. The St. Sampson's gas-driven station consists of one battery (capacity 50 kw for 10 hours), two 180-kw "Campbell" gas engine sets, two Daniels gas producers, one 20-ft. diameter gas holder, two circulating water pumps and water storage tank. The gas engines consist of two four-cylinder vertical engines of the enclosed type, working on the "Otto" cycle, each developing 300 B. hp on producer gas, the normal speed of each being 250 r.p.m. The total cost of the steam plant was $18,210, against the total cost of the gas plant of $16,000. Full data are given of the comparative generating costs in six months between May and October. This comparison shows in each month a difference in favor of gas plant per kw-hour generated. This difference amounted in six following months to 0.284, 0.518, 0.198, 0.256, 0.692 and 1.026 cents. Exact figures are also given on a six-hours' trial run of the gas engines in St. Sampson's station, the average power being 280 hp. The total coal used in producer was 1,664.75 pounds. The total coal used in boiler, 242.75 pounds. (This gives a total coal consumption of 1.13 pound per hp-hour.)—Lond. *Elec.*, November 25.

Double-Acting Gas Engines.—WITZ.—In an article on double-acting gas engines, results are given of some tests carried out by him last March on a double-acting gas engine working on the Otto cycle. The principal dimensions of this 250-hp engine, which was built by the Otto Company, of Deutz, were: Diameter of cylinder, 540 mm. (21.2 in.); stroke, 700 mm. (27.6 in.); speed, 150 r.p.m.; weight per brake hp, 80 kg. (178 pounds). Gas was furnished by a Deutz gas producer, being cleansed solely by two coke scrubbers. The coal used had a calorific value of 14,600 B.T.U per pound and contained 3.1 per cent. of ashes and 17.1 per cent. of volatile substances. With a mean load of 222.5 B. hp, the following figures were obtained: Coal consumed by the producer, 161.5 pounds per hour; water consumed in the producer, 140 pounds per hour; ditto in the scrubbers, 3,180 pounds per hour. The temperature of the gas leaving the scrubbers was 170° C., and the calorific value of the gas ranged from 2,280 to 2,444 B.T.U. per pound. As regards the consumption of coal, and of water for cooling the engines, the following figures are quoted: Coal, 0.744 pound per B. hp-hour; cooling water in the cylinder, 46.7 pounds per B. hp-hour; cooling water in the piston, 17.6 pounds per B. hp-hour. (A comparison is made with the result of the six hours' test in Guernsey mentioned in Campbell's paper abstracted above. The total amount of coal used in the boiler and producer per B. hp-hour was 1.12 pound in the case of the Guernsey engine, against 0.744 pound for the Deutz engine. The coal appears to have been of good average quality in both cases and the difference is probably chiefly attributable to the fact that the Deutz engine is double-acting.)—Lond. *Elec.*, November 25; from *L'Eclairage Elec.*, October 22.

REFERENCE.

Induced Draft.—An illustrated description of a steam-driven, induced draught plant in connection with an installation of marine type boilers. The fan runner is constructed of steel plates, and is 10 ft. in diameter, and the fan itself is capable of maintaining a vacuum, in the suction, of 1½ in. water gauge, when passing 122,000 cu. ft. of gases per minute at a temperature of 600°.—Lond. *Elec.*, November 18.

TRACTION.

Heavy Electric Traction.—LYFORD AND SMITH.—A study of the electrical equipment of certain divisions of the Long Island Railway, on which electricity is to be adopted. Motor car trains will be used, varying from one to ten cars in length. The stations will not average over 8 km. apart and the speed will be from 50 to 56 miles per hour; 200-hp motors will be used. The writers conducted a series of tests to determine the power required, and have prepared a formula. Tests recently made in Michigan by the authors indicate that this formula covers the conditions better than either of the two other formulæ in general use. They then discuss the power required and submit a number of curve sheets, and records made from steam locomotives and motor cars under similar conditions.—*St. R'y Jour.*, December 3.

Lima.—RAE.—An article on improvements made in the steam plant of the Lima Electric Railway & Light Company, Ohio. The plant is operated non-condensing and its exhaust steam is sold for heating. The floors are on different levels, the boiler room being the lowest, on level ground, while the intermediate room is slightly raised above and the engine room floor is at a height sign. The boilers are of the horizontal water-tube type, each of 400 hp capacity and are equipped with inclined grate mechanical stokers. The main header is located in the intermediate room upon a level with the engine cylinders and steam drums of the boilers. It is furnished with valves by which steam may be delivered through it from any boiler to any engine and any boiler or engine may be cut out if desired. Steam is delivered to the engines through steam receiver separators and open feed-water heaters are used. The power equipment consists of three direct-connected, 400-hp units driving 300 to 350 kw, 2,300-volt, alternating-current generators.—*St. R'y Jour.*, November 26.

Telpherage.—An illustrated article on electric telpherage.—*Stahl und Eisen*, November 1.

REFERENCES.

Regenerative Control.—With respect to Raworth's system of regenerative control of tramways recently noticed in the Digest, Sayers makes some critical remarks to which Raworth replies.—Lond. *Elec. Times*, November 3, 10, 17, 24.

Permanent Way for Tramways.—TAYLOR.—A paper read before the Rugby Eng. Soc. on track construction, special work of track, construction of rail bed, foundation and paving.—Lond. *Elec.*, November 18.

Manganese Steel in Railroad Practice.—An account of the experiments made by the Pennsylvania Railroad in its steam railroad terminal track work in Philadelphia. A manganese steel rail was in use four years, it was then removed, the worn parts pressed up from below, and replaced in service. The manganese frogs have lasted from ten to fifteen times as long as ordinary steel frogs.—*St. R'y Jour.*, November 19.

Electrolysis of Water Pipes.—A long illustrated abstract of a report of Knudson on extended damage done to the water pipe system of Bayonne, N. J., by the tramway return currents.—*Eng'ing News*, November 17.

ELECTRO-CHEMISTRY AND BATTERIES.

Electric Iron and Steel Furnaces.—A very long illustrated abstract of the report of the Canadian Commission on electric iron and steel furnaces in Europe, the conclusions of which were recently given in the Digest. The present abstract gives nearly in full the report of the original tests made by the commission and the argument of the metallurgical expert, Harbord, on which the conclusions of the commission are mainly based. The same issue contains an article by Neumann in which electric furnace methods for use in iron and steel manufacture are compared, with respect to cost, with the ordinary metallurgical methods. The author reaches the conclusion that the present metallurgical methods have to fear no competition from the electric furnace with respect to the problems of reducing pig iron from ores and of making steel of the Bessemer and open hearth grades, except in countries where the local conditions are specially favorable for electric furnace work. On the other hand, even in the principal iron countries, the electric furnace should be expected to find introduction for making high-grade ferro-alloys and for making special steels of the crucible steel grade. Thus the conclusions agree with those of the Canadian Commission.—*Electrochem. Ind.*, December.

REFERENCE.

Dynelectron.—BURR.—A fully illustrated article under this title deals with the carbon cell of Reid, which was described in ELECTRICAL WORLD AND ENGINEER of December 12, 1903. A criticism of the cell was noticed in the Digest January 23, 1904.—*Iron Age*, December 8.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Magnetomotive Forces.—GOLDSCHMIDT.—An illustrated description of a method of measuring magnetic potential drop. It was devised to test actual steel field magnets which were suspected of being faulty in quality and casting. The principle is as follows: To measure the "magnetic potential drop" between the points *a* and

b in the yoke of a continuous-current machine, two laminated iron cores, *A C* and *B D*, as shown in Fig. 1, are placed on *a* and *b*, respectively, in the manner shown, the gap, *C D*, being from ¾ in. to ⅞ in. By this arrangement a small "magnetic shunt" or "by-pass" is formed to the yoke. This shunt will take up a small amount of the magnetic flux. Point *C*, for instance, will show north polarity, point *D* south polarity and a small compass needle placed between *C* and *D* will assume a position pointing with its south pole to *C*. The limbs, *A C* and *B D* carry two coils, S_1 and S_2, which are excited with a current so that they counteract the magnetic potential between *a* and *b*. If the ampere-turns of S_1 and S_2 are increased sufficiently

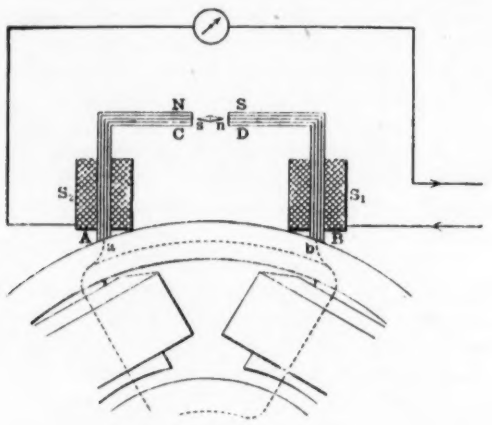


FIG. 1.

FIG. 1.—MEASURING MAGNETOMOTIVE FORCES.

to overcome the magnetic force of *a-b*, then the flux in the "magnetic shunt" would reverse, the polarity of *C* would become north and the polarity of *D* south, and the compass needle would turn into the opposite direction. If the current is adjusted in S_1 and S_2 so that the compass just begins to move from one position to the other, the magnetomotive force of the coil is equal to the magnetic potential difference between *a* and *b*, and thus represents directly without any further calculation the amount of ampere-turns required to drive the flux through the yoke of the machine. Fig. 2 shows the apparatus as applied to a direct-current machine. Some applications of the method are as follows: Measuring the drop for the different yokes

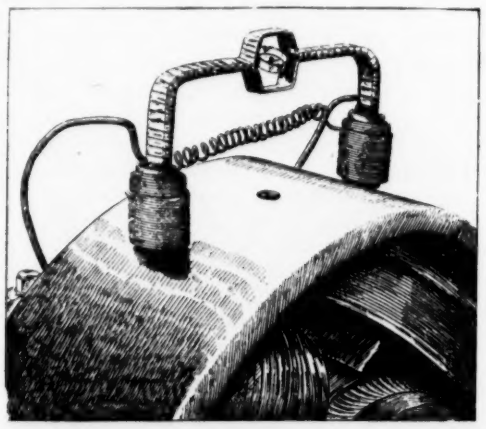


FIG. 2.—MEASURING MAGNETOMOTIVE FORCES.

and parts of a direct-current machine so as to detect irregularities and blow-holes in the iron; getting the full magnetizing curves of the armature teeth of electrical machinery; detecting bad joints in any part of the yoke of direct-current machines. The method may also be applied for measuring the direct current in a conductor—say, a feeder cable—without inserting the ammeter or cutting the cable in any way. The method is stated to be pretty accurate.—Lond. *Elec.*, November 25.

Compass.—A note on an instrument, devised by Heit, to be used in connection with the compass for registering automatically, minute by minute, the direction followed by the vessel. "The compass card, instead of having at its center an agate resting on a fixed steel point, is fixed on a steel pivot, which rests on a fixed agate. The latter is immersed in a small quantity of mercury, which serves to conduct the current of electricity that makes possible the registering of the movements of the compass. For this purpose the card has attached to it a small silver index, which is kept in constant electrical communication with the pivot by a fine and flexible wire. In the usual position this index does not touch the fixed basin surrounding the card, but by means of the electrical current the circuit is rapidly closed and opened, with the result that the angle of the boat with the meridian is registered. For this purpose the basin is divided into a certain number of sections, isolated from each other and corresponding in each case to a special circuit, the registration being made on a sheet of paper by means of a spark produced by a small induction coil. Certain sections of the basin also correspond to certain call bells, the commander thus being instantly informed of any abnormal deviation in the direction of the vessel." The apparatus also gives the speed of the boat by registering the revolution of the screws, a circuit being closed and a signal sent to the receiver at each stroke of the engine. In case of accident reference to the chart enables any alteration in the position of the vessel, and the time of such alteration, to be detected, so that responsibility can be located.—Lond. *Elec. Eng.* November 25.

Acelylene Standard of Light.—FERY.—A paper in which the author maintains that acetylene will burn satisfactorily for photometric purposes when issuing from a capillary tube of glass or steatite. He uses a thermometer tube about half a millimeter in internal diameter. A flame 24 mm. high gives about 12 cp. Its maximum of luminosity is at one-third of its height. If, therefore, the jet changes in height, the point of maximum luminosity only shifts by one-third of the amount, and the risk of variation is lessened to that extent. It is essential that the tube should be a bad conductor of heat. Otherwise the aperture, remaining cool, is clogged with distillation products. The height of the flame should be from 22 mm. to 28 mm. The consumption of gas is 7 liters per hour.—Lond. *Elec.*, November 25; from *Journal de Physique*, November.

REFERENCES.

Meter.—The German Reichsanstalt has admitted the O'Keenan meter for direct current for calibration by the Government offices. The meter registers kilowatt-hours for the voltage stated on the dial. In accordance with the legal requirements the construction and method of operation of the meter is described and illustrated. Instructions are given for testing the meter.—*Elek. Zeit.*, November 24.

Moving Coil Instruments.—An illustrated description of direct-current measuring instruments of the moving coil type, made by an English company with a special view of enabling the user to easily verify and adjust them.—Lond. *Elec. Rev.*, November 25.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Magnetic Wave Detector.—PEUKERT.—A description of a wave detector based, like two of Marconi, on the fact that the magnetic hysteresis of iron is changed in a periodically varying magnetic field. The advantage of the detector over those of Marconi is that the message is received on a strip of paper. The construction is shown in Fig. 3. A magnet, *A B*, rests on a horizontal axis. In the magnetic field produced by this magnet there is an iron or steel body, *E E*, with some windings of wire, the terminals of which are connected to two slip rings, *S S*. The latter are mounted insulated on the axle of the iron body and are touched by the two brushes, f_1 f_2. The iron body is revolved by means of an electric motor. If the iron body revolves with constant speed, the iron is subjected during each revolution to a magnetic cycle, which requires a certain amount of magnetization energy, the value of which depends on the condition of the iron body and on the intensity of the magnetic field. On account of this magnetization or hysteresis energy a torque is exerted on the magnet resulting in a deviation of the magnet in the sense of the revolution of the iron body. This deviation measures directly the hysteresis. (The eddy currents produced in the iron body would not produce a deviation of the magnet, as can be shown by replacing the iron body by sheet copper of the same dimensions; in this case the magnet is not deviated.) With sufficiently constant speed of rotation of the iron body the magnet remains in this deviated position, although the speed of the iron body may change within certain limits. To obtain as constant a deviation of the magnet as possible, the latter is provided with a damper suspended in oil. If now an alternating current is passed through the winding around the iron body, the hysteresis of the iron at once gets smaller, the torque decreases and the magnet moves in a direction opposite to the direction of rotation of the iron body. When the alternating current is interrupted the

magnet returns to its former position. This motion is used by the author for making a contact. For this purpose the magnet is provided with a needle, Z, which can make contacts at K_1 or K_2. To detect electromagnetic waves, one brush, f_2, is connected to the vertical wire, the other brush, f_1, to earth. Waves which touch the vertical wire pass through the winding around the iron body and the

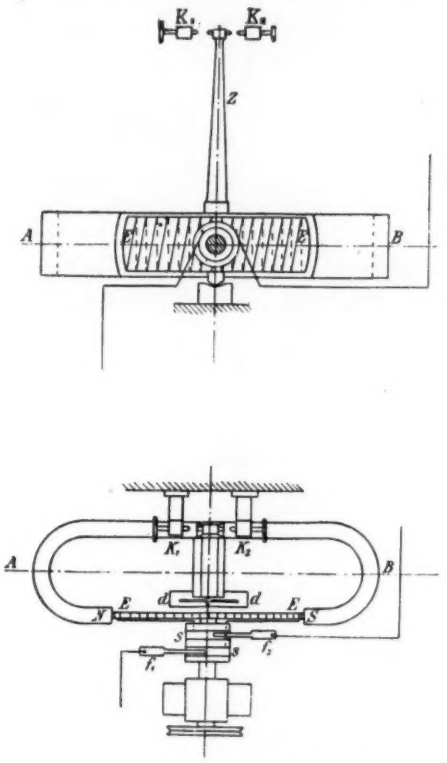


FIG. 3.—MAGNETIC WAVE DETECTOR.

action is as described before. The connections are shown in Fig. 4. The relay, R, is connected with a battery to the contact to be closed. By the action of the waves contact is made at K_2, so that the circuit containing the relay is closed. This acts then in a well-known manner on a registering device. For a longer action of waves the registering device gives a dash, for shorter duration it gives a dot, so that the ordinary telegraphic symbols can be received in this way.

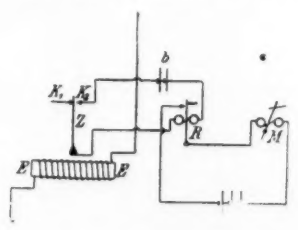


FIG. 4.—MAGNETIC WAVE DETECTOR.

The author remarks that a similar instrument has been patented in the United States, October 14, 1902. In the latter device the magnet revolves and the contact is made by the iron body provided with the windings.—*Elek. Zeit.*, November 24.

MISCELLANEOUS.

Address to Students.—SWINBURNE.—An address delivered to the students of the British Inst. Elec. Eng., on "Some Difficulties in Getting On." The first difficulty is that nobody knows in advance what is going to be his work. A young man has probably the vaguest idea of what his life work will be, and that idea time will show to be quite wrong. Probably each man should have a general knowledge of applied physics and chemistry and mathematics, and a special knowledge of one or two subjects. "The special knowledge may never come in useful, but the chances are that in the blind stumblings we call our careers a specialty may be very valuable." One of the great difficulties is to keep knowledge in a polished state ready for immediate use. In practice it may have to lie idle for long periods and then be wanted very much on short notice. The great thing is to master a certain number of broad fundamental principles which give a starting point for refreshing old knowledge or acquiring new. "One of the greatest difficulties in getting on arises from the idea, which is carefully fostered among English science teachers, that there is something degrading in applying science, and that business ability is an inferior quality which is to be despised." If teachers for colleges are chosen from the students who have been taught there, there is "an unavoidable tendency for education to become more and more unpractical. Ordinary school education is entirely and hopelessly useless. * * * The only possible use of the present day public school and university training is to make more schoolmasters. A man who does well at school and college is fit to be a schoolmaster or clergyman and nothing else. He may do other things in spite of it, especially as his competitors are equally badly off, but that is all that can be said." Mr. Swinburne earnestly urged any of his hearers who have the idea that there is something noble and superior about "raw science," or who thinks little of business men, to get rid of all such notions if he hopes ever to get on. "If you look round the electrical industry, or round the industries generally, who are at the top? Always the business men. The men at the head of large industries generally know very little science. A man may run a large electrical industry with the most vague ideas as to the true relation of the electrostatic and electromagnetic systems of units; in fact, he may think power, force and energy are very much the same kind of thing, if looked at in a broad commonsense way without any scientific prejudice. If he wants good technologists he employs them. If he wants practical men who can take commercial responsibility he pays good salaries; if he wants men full of book knowledge he pays low salaries, but he does not generally want them. * * * The business man at the top, the practical engineer in the middle, and the unpractical engineer, or the raw scientist at the bottom." A man's value to the world at large may generally be roughly estimated by the income he earns. The business man comes out far away above the engineer. He employs the engineer; the scientific man is his servant. Mr. Swinburne does not deny that textbook science is of priceless value; of course it is; and the more scientific knowledge the leading engineers have, the better; but most suffer from too little common sense in proportion to scientific knowledge. "Schoolmasters naturally have the idea that what they are good at is most important, so a huge convention is set up. The value of what is called learning, culture, education or more often knowledge, is purely a convention with no foundation in fact. What is generally known as a learned man or scholar has only a memory full of interesting but useless items gathered from the scrap heap of the past." Mr. Swinburne then says that while in general a man's earnings are a rough test of his value to the world, a great exception must be made in the case of genius. A genius does not work for a given employer; he works for the world at large; and the world at large does not pay him. "It would be ludicrous nonsense to say that the value of Newton or Faraday could be reckoned in terms of their pecuniary earnings. They did grand work apparently because they were impelled to do it without any selfish motives. This is true of the great scientific men of to-day." The definition of an engineer as a man directing the great sources of power in nature for the use and convenience of man, is considered to be bad, and to be really the definition of a scientific man. "It is incomplete as applied to an engineer, because it does not take into account the sordid element of price. An American definition is much better: 'An engineer is a man who can do for one dollar what any fool can do for two.' This is not poetical, and is useless for oratorical purposes; but it is right." Every design, every engineering manufacture, and every piece of engineering is only a question of price. One of the greatest difficulties in getting on is the poetic idea, that there is something degrading or deteriorating in taking a money view of everything. "You may say, 'We take higher views of life than that; there is something better for us in our careers than money grubbing.' So there is; I heartily agree with you; and when you have grubbed some money and are at liberty to attend to higher things, I would like to be allowed to join you." Money is nothing in itself, it is only a means, and making it is merely a way of going ahead of your fellows. "Business is really a higher title than profession." Mr. Swinburne points out that openings in electrical engineering are scarce at present in England for young men. Income for a young man is very little criterion of real value. A hard struggle is very good for a young man who has anything in him. It gets him into the way of overcoming difficulties, so that when he gets above the small obstacles he goes on

overcoming difficulties, so that when he gets above the small obstacles he goes on overcoming large ones from the mere force of habit. Nearly all great men rise from almost nothing with infinite trouble in their youth.—Lond. *Elec.*, November 18.

Training of Electrical Engineers.—RUDDLE.—His presidential address to the Dublin Section of the British Institution of Electrical Engineers. He points out that the students should have an innate love of the science and art of electrical engineering and for learning for the sake of finding out hidden things. They should give more than lip service—answering of examination questions and obtaining passes and certificates. A serious danger is now developing owing to the great inrush of young men into anything electrically named; many of them seem satisfied to acquire just enough technical knowledge to secure a post. Once secured they settle down and perform their routine duties more or less thoroughly and gradually drift out of keeping their training up-to-date. It is not enough to have sufficient knowledge for present needs; one must look ahead and be prepared for developments. Before a student can expect to secure a position of any importance, he has yet to acquire the commercial or business side of his education. Students should take every opportunity of seeing works in practical operation; they may feel utterly at sea with regard to much that goes on, but to an observant mind there are many good lessons to be learned, and hence obtained. They will be of much service in after life. Students should ask questions when visiting plants.—Lond. *Elec.*, November 18.

Export Statistics.—DIGBY.—An article on six years of British and American electrical export statistics. The results are given in form of numerous tables and diagrams which, of course, cannot be abstracted. Some interesting details are that in the British Board of Trade returns on the British export trade the export to the United States is not regarded of sufficient importance for separate computation since 1898. With respect to the distribution of the export trade zones of electrical machinery exported from the United States, the United Kingdom takes nearly one-half and the British North America nearly one-fourth of the exports in 1903. Despite the greater distance to be traversed Great Britain has always sent and still sends a greater value to the numerous South American republics than does the United States.—Lond. *Elec. Rev.*, November 25.

REFERENCES.

Carbon Making.—ORNSTEIN.—An article on the basis of a lecture of Zellner on recent improvements in carbon making. After some general remarks, especially on Acheson graphite and carbon brushes (see the abstract above under "Dynamos"), the author discusses at great length the preparation and composition of carbons for flame arcs.—Lond. *Elec. Rev.*, November 25.

Manufacturing Plant.—A fully-illustrated description of the new works of Bruce Peebles & Co., at East Pelton, Edinburgh, manufacturers of dynamos, motors, etc.—Lond. *Elec. Eng.*, November 25.

Biographical.—Biographical sketches with portraits of Sir J. W. Swan, C. A. Parsons, Alex. Siemens and R. K. Gray.—Lond. *Elec. Rev*, November 25.

Westinghouse Oil Circuit-Breakers.

The Westinghouse Electric & Manufacturing Company has begun to place on the market a new automatic oil circuit-breaker, known as electrically-operated Type E. It is perfectly adapted to the most modern system of distant control and is designed for voltages from 3,300 to 25,000.

Systems of very high voltage and capacity have received much attention from engineers, but a definite demand has arisen for a piece of apparatus of somewhat smaller capacity, which shall be compact, reliable and suited for electrical operation. The Westinghouse system of solenoid operation is especially adapted to such a form of apparatus and has been used in the new line of circuit-breakers.

The circuit-breaker is made in single-pole units, each being mounted apart from the switchboard in a brick or concrete compartment. Two, three and four-pole combinations are made by placing the units side by side. The base of each unit is of treated soapstone and holds two heavy porcelain insulators which carry the stationary contacts and the connection to the external circuit. The movable contacts are at the ends of a U-shaped metal casting fastened at the center to a rod of treated wood, which is moved up and down by the operating mechanism in closing or opening the circuit. The final arc on breaking the circuit is taken by an arcing tip which may easily be replaced.

The contacts are of the typical Westinghouse design and deserve especial notice. The movable contacts are in the shape of truncated cones and fit into corresponding surfaces in the stationary contacts which are made up of a number of copper springs. This arrangement not only gives a large area of contact, but insures a positive contact over its entire surface, and entirely prevents "freezing" under any condition of overload. The tanks are liberally insulated and the

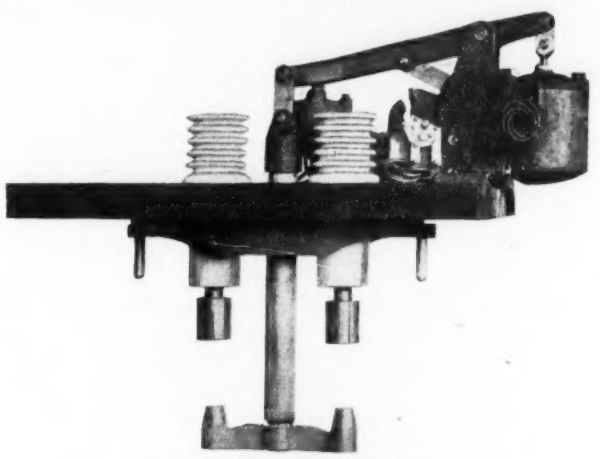


FIG. 1.—OIL CIRCUIT-BREAKER.

inner surface so shaped as to reduce the amount of oil required, and therefore the fire risk to a minimum. The open position is in all cases maintained by gravity.

A simple system of levers and toggles is mounted on the top of the base and a powerful electromagnet is arranged with its movable core attached to the lever system, so that when the magnet is energized the circuit-breaker will be closed. The standard voltage used on the solenoid is 125 volts. A second electromagnet acts as a tripping coil and may be controlled by a relay of any desired type. A small single-pole, double-throw switch is mounted on the base and is operated by the motion of the levers in opening or closing this

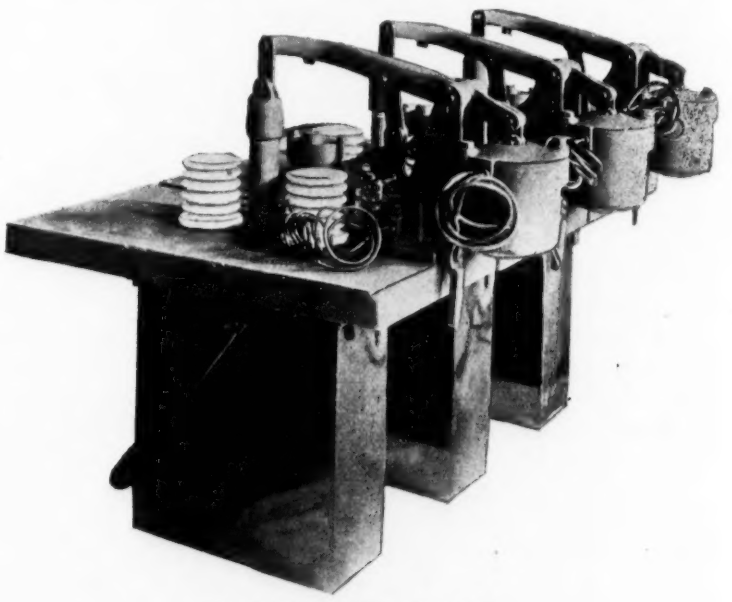


FIG. 2.—OIL CIRCUIT-BREAKER.

the surface of the oil instead of at the bottom where there is almost always a certain amount of sediment. These circuit-breakers have no live parts exposed. The oil tanks are firmly held in position by circuit; it controls the tell-tale indicator and lamp which are mounted in view of the operator.

The entire mechanism is extremely compact and solid in construction, while the insulation has been carefully provided for. As in other Westinghouse oil circuit-breakers, the break takes place near special holders, which, by the simple movement of a lever, may be removed and all contacts examined without disturbing any other part of the circuit-breaker.

The ultimate breaking capacity of the Type E circuit-breakers is, for single-phase, 6,000 kw; two-phase, 12,000 kw; three-phase, 10,400 kw. They will open circuits of these capacities under any condition of overload or short-circuit.

Apparatus for New Power Plant at Baltimore.

An interesting feature of the recently announced developments in the Baltimore electric power enterprise is the exclusive adoption of steam turbines as the prime-mover. A contract recently closed with the Westinghouse Machine Company provides an initial equipment of 4,000 kw in two generating units of 2,000 kw each. A Westinghouse electrical equipment, complete and modern in every particular, has also been contracted for.

Officers of the company state the power plant will embody the latest developments in steam and electrical engineering. The building is to be of fire-proof construction throughout, the structural steel frame also serving as supports for the boilers and the overhead coal bunkers. Being located outside of the congested districts of the city, all the boilers and heavy machinery will be on the ground floor. Floors and roofs will be of steel-concrete construction. The company has secured a lot fronting on Gould Street and extending to the Patapsco River. This property comprises 6.4 acres and by filling in to the wharf line over three acres will be added to the area, which will give the company sufficient space to take care of the electrical needs of Baltimore for a long period. The location of the plant on the water front, with the Baltimore & Ohio and Wabash Railroad systems adjoining, affords ample facilities for securing coal either by rail or by water. The distance from the center of the city to the new power house is about two miles and a half.

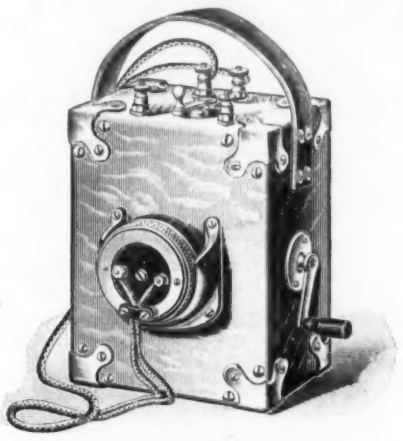
The steam turbine plant will operate with a boiler pressure of 175 pounds and a superheat of about 100° F. A high-vacuum condensing system will be installed, capable of sustaining a vacuum of 28 in. at full load on the plant. The plant in its entirety has been designed on the separate unit plan, which virtually consists of a number of distinct power plants placed side by side, each entirely separate from the other, but each capable of helping out the other in case any link in the system should be disabled. This holds good through the coal-handling apparatus, the boilers, steam piping, turbines, condensers, generators, switchboard, underground cable, etc., from the coal pile to the customer's building. In addition to this precaution against interruption of service, the company will install a large storage battery which will ordinarily "float" on the system. The construction work is already under way and will be pushed as rapidly as possible in order that the plant may be completed in all respects and running smoothly by July next.

The Baltimore Electric Power Company was recently organized with an authorized bond issue of $7,500,000 and a capital stock of $3,500,000. The officers of the new company are: D. E. Evans, president; R. F. Bonsall, treasurer; W. T. Spring, secretary. Pending a permanent organization, the directors of the new company are H. W. Webb, D. E. Evans, John T. Stone, W. T. Burroughs, R. F. Bonsall, W. T. Spring and George R. Webb.

Test Telephones.

The Connecticut Telephone & Electric Company, of Meriden, Conn., has placed upon the market a new Bell style test telephone, said to be the only instrument of its kind manufactured by an independent manufacturer. This instrument is made up on the same general lines as the Bell telephone test set. The base contains the generator and polarized buzzer. The receiver is placed in a clip in a socket on the side of the case, a two-point switch being used for cutting in the generator or receiver as required. No batteries are required as the receiver is used as both transmitter and receiver. The receiver in this set is of extra large and powerful design.

This company is also placing upon the market a new style of test instrument which is a complete telephone equipped with its latest solid-back transmitter, watch-case receiver, generator, ringer, and two cells of pocket dry battery. This instrument will work any distance and is suitable for testing electric light, telegraph and telephone lines, cables and wiring in buildings. This instrument is in general use in the army, and is also used as a street railway telephone. Plug and weather-proof jack boxes are furnished for mounting on poles. Both the instruments are light and strong. They are made up in two sizes, the larger being for heavily loaded toll lines.



TEST TELEPHONE.

The Connecticut Company is specializing on test sets, and has made a decided hit with its various styles.

Electrical Development in San Francisco.

Additional details of the plans by which the California Gas & Electric Corporation is to furnish the United Railroads of San Francisco with all of the power for the operation of its street railway lines have been announced. Under the contract recently signed the Gas & Electric Corporation will begin, January 1, 1906, to deliver at the railway sub-stations sufficient power for all of its purposes. This will permit of the shutting down of all the United Railroads' electric generating plants in the city. Just what disposition will be made of the engines and generators now operated by the street railway company has not been decided. It is understood that the cable road drums will be driven by electric motors instead of the present engines. The electric power needed by the United Railroads will be generated at various water power stations of the California Gas & Electric Corporation and transmitted to San Francisco at 55,000 to 60,000 volts, 60 cycles, three-phase. In the water power company's sub-station in San Francisco several 4,000-kw cycle-changers will be installed to change this current to meet the demands of the rotaries in the United Railroads' sub-stations. This means that the 60,000-volt, 60-cycle current will be changed to 13,200-volt at 25 cycles.

The railroad company now has three sub-stations with a total capacity of 7,000 kw, all supplied with 13,200-volt current from the North Beach power station. The company also operates a direct-current power station at Bryant and Alameda Streets. Its total capacity is 4,400 kw in 14 units. Among these are eight 400-kw Siemens & Halske type generators direct-connected to four 1,200-hp triple-expansion marine type engines. Plans are in preparation to make a sub-station of this plant. The four smaller engines and six 200-kw generators will be taken out and five 1,000-kw rotary converters erected in the space vacated. The daily average power requirements of the railway system are about 115,000 kw-hours, with a maximum evening peak of 9,000 kw. This will be materially increased when the contemplated change of motive power on several of the cable roads now in operation has taken place, and 40-ft. double-truck cars have superseded the old single-truck cars. The California Gas & Electric Corporation will install in San Francisco in order to prevent interruption of the electric power service in case of trouble on the long-distance transmission lines, a gas engine reserve station. This plant will include three 5,000-hp Snow Pump Works gas engines, each direct-connected to a 25-cycle, 13,200-volt, three-phase generator. To regulate possible fluctuations in the voltage, due to the great length of the transmission lines, one of these gas engine units will be operated continuously in parallel with the 25-cycle end of the cycle changers. This plant will be considerably in advance of anything before attempted commercially for such a service. Engineers are awaiting with interest the outcome of the efforts to operate such large gas engine generating units in synchronism with each other for street railway requirements.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—On Wednesday and Thursday a severe reaction was experienced on the Stock Exchange, several of the principal securities dropping several points. At the close of the week the market was irregular on recovery. The absence of any pressure on account of money was a noticeable incident, and heavy buying by London was a feature in the depression. On Thursday the transactions aggregated 2,883,000 shares, which volume of business has not been equalled since the panic in May, 1901. There was a general liquidation of weak speculative accounts. The easing off of the copper market and a relaxation of the recent demand for the metal hardly accounted for the furious drive at Amalgamated Copper, which declined 20 points, while reports of greater activity in the steel industry failed to check the sympathetic downward movement which United States Steel shares suffered. Both stocks, however, figured prominently in the recovery at the end of the week. In varying proportions the entire list experienced the effect of the reaction and of the subsequent rally. Brooklyn Rapid Transit, of which 136,300 shares were sold, dropped nearly 12 points during the excitement, the highest and lowest prices being 68⅝ and 56, respectively, the closing quotation being 65, which represents a net loss of 5 points. Metropolitan Street Railway fluctuated between 124¾ and 116½, closing at 121½, a net loss of 2¾ points. Interborough Rapid Transit, which is a "curb" stock, moved between 159½ and 168⅞, closing at 164, ex. div., which is a net increase of ¼ point. Of the electric stocks, General Electric made the widest movement, the range of prices being 182½ and 192, the closing quotation being 189—a net loss of 2¼ points. Westinghouse common lost 2½, and preferred 5 points on the week's business, the closing quotations being 181½ and 192, respectively. Western Union was not much affected, closing at 92½, which is a fraction below the quotation last recorded. Allis-Chalmers common closed at 18⅜ and preferred at 68, these figures representing net losses of ⅝ and 2 points, respectively. In the "curb" market, which acted in sympathy with the main exchange, serious breaks occurred, the total sales being nearly 1,000,000 shares, of which about 650,000 represented mining stocks. There were sharp recoveries, however. Following are the closing quotations of December 13:

NEW YORK

	Dec. 6	Dec. 13		Dec. 6	Dec. 13
Allis-Chalmers Co.	18	15	Electric Vehicle	16	16
Allis-Chalmers Co. pfd.	69	61	Electric Vehicle pfd.	23	23
American Tel. & Cable.	91	92	General Electric.	188	183¾
American Tel. & Tel.	148	143	Hudson River Tel.	..	..
American Dist. Tel.	..	..	Interborough Rap. Tran.	168	161
Brooklyn Rapid Transit.	68⅛	57¾	Metropolitan St. Ry.	123	119¾
Commercial Cable.	..	..	N. Y. & N. J Tel.	..	..
Electric Boat	40	35	Marconi Tel.	..	..
Electric Boat pfd.	68	70	Western Union Tel.	91½	92⅛
Electric Lead Reduction	⅛	⅛	Westinghouse com	182	178
			Westinghouse pfd	194	190

BOSTON

	Dec. 6	Dec. 13		Dec. 6	Dec. 13
American Tel. & Tel.	147	144	Western Tel. & Tel. pfd.	*101	*100
Cumberland Telephone.	122	122¼	Mexican Telephone.	2	1⅞
Edison Elec. Illum.	251	250	New England Telephone.	*140	137
General Electric	187	184	Mass. Elec. Ry.	14¾	14
Western Tel. & Tel.	21	21	Mass. Elec Ry. pfd.	62¼	61¼

PHILADELPHIA

	Dec. 6	Dec. 13		Dec. 6	Dec. 13
American Railways.	48⅛	48	Phila. Traction.	98¾	98½
Elec. Storage Battery.	81	78	Phila. Electric.	10⅛	9⅝
Elec. Storage Battery pfd.	..	78	Phila. Rapid Trans.	18	17¼
Elec. Co. of America.	10¼	10			

CHICAGO

	Dec. 6	Dec. 13		Dec. 6	Dec 13
Central Union Tel.	..	..	National Carbon pfd.	109	109½
Chicago Edison.	172	172	Metropolitan Elev. com.	24	23
Chicago City Ry.	183	185	Union Traction.	12	11⅛
Chicago Tel. Co.	142	..	Union Traction pfd.	42	40
National Carbon.	44	1:¼			

* Asked.

BRITISH WESTINGHOUSE REPORT.—The directors of the British Westinghouse Electric & Manufacturing Company, Limited, in their report for the year ended July 31 last, state that the accounts show a profit of £50,550. After providing for debenture and loan interest and for the further items set out in the profit and loss account, a balance of £2,809 remains, which the directors propose to carry forward. A considerable sum for the maintenance of the large machine tools has been charged to revenue during the year under review, and, latterly, patterns, drawings, etc., have been charged to revenue. The directors, therefore, are of the opinion that the sum of £10,500 provided for depreciation is sufficient to meet requirements. The buildings have been well maintained, and, in the opinion of the directors, no special provision for depreciation thereon is at present necessary. The board has not deemed it necessary to write off any depreciation on patents in view of new ones that have been taken out. The result obtained at the close of the first complete year of manufacturing has shown that the general expense and outlay incident to the development required in connection with the company's plant at Trafford Park has been much greater than the management anticipated. The varied, and, to a large degree, novel, character of the work undertaken more than a year ago required additions in equipment of many kinds, and the expense met with in forming the organization required to execute such work has involved considerable outlay. These expenditures have, however, placed the factory in an advantageous position to execute orders in the future for large generating units. The management has been active in perfecting the company's organization in all departments, and improvements materially curtailing manufacturing costs and diminishing selling and administration expenses have resulted. A larger amount of work is now being turned out for a smaller amount of labor than formerly, and a matter of equal importance is that the proportion of contracts executed in the works, as compared with finished material purchased from other manufacturers to fill such contracts, is increasing, while at the same time the margin of profit on work executed in the factory is moving upward. While it was not possible to declare a dividend upon the preference shares, the outlook is one which encourages the directors to look forward to an improvement during the current year. The following particulars are given covering orders received during the past three years: Orders received during the year ended July 31, 1902, £932,000; during the year ended July 31, 1903, £1,567,114; during the year ended July 31, 1904, £927,336. During the year under review business was inactive, and few large contracts were placed; but, notwithstanding the general depression, the keen competition between manufacturers at home and the vigorous efforts of continental firms to secure British business, the company has taken orders during the first three months of the current year aggregating £311,000, as compared with a total of £210,000 for the corresponding period of last

DIVIDENDS.—The directors of the United Traction & Electric Company of New Jersey have declared the regular quarterly dividend of 1¼ per cent., payable January 2. The Manchester Traction Company has declared a regular quarterly dividend of 1½ per cent., payable January 16. The Twin City Rapid Transit Company's directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable January 2. The Westinghouse Air Brake directors have declared the regular quarterly dividend of 2½ per cent. and 2½ per cent. extra, payable January 10. Chicago Telephone directors have declared the regular dividend of 2½ per cent., payable December 30. Directors of the United Railways Investment Company, of San Francisco, have declared a semi-annual dividend of 2 per cent. on the preferred stock, payable January 3. This is an increase of ¼ of 1 per cent. over the one paid in July, this year.

WASHINGTON TROLLEYS.—The street railway company has a franchise and practical monopoly and owns the Washington Railway & Electric Company and all the electric light and power plants in the district. The beginnings of this consolidation were made by Oscar T. Crosby, formerly with the General Electric Company, and his associates. The company has $16,636,000 of 4 per cent. bonds, $8,500,000 of preferred stock and $6,500,000 of common stock. The common sells at 28 and holds the equity of the future. The 5 per cent. preferred begins payment of its initial dividend under its charter in December and it has accumulated 15 per cent. cash surplus in its treasury to insure the payment of regular dividends. The company is now earning just about this 5 per cent. on the preferred, selling about 87 and is gaining $100,000 per annum.

A TELEGRAPH COMBINATION is being once more discussed. It has been a fruitful theme of rumor and agitation these ten years past, with variants of one kind and another, one version being an alliance between Postal Telegraph and Bell Telephone interests. The *Wall Street Journal* gives the latest aspect of the gossip: "The entrance of Kuhn, Loeb & Co. into Missouri Pacific and the arrangement of differences between Pennsylvania and Gould interests will, it is understood, be followed by a merger of Western Union and the Mackay Companies, although the latter consummation may not be arrived at for some little time. It will be remembered that when the relations between the Gould interests and the Pennsylvania became acute, the latter ordered the Western Union off its lines, and, when Western Union disregarded this order, chopped down the telegraph poles, and "used them as they would old ties.' The Western Union service was superseded by the Postal Telegraph along the

lines of the Pennsylvania system with inevitable loss of considerable business to the Western Union Company. Now that relations between these interests have been practically harmonized, it hardly seems fair that Western Union should suffer from the effects of the quarrel. How to prevent it from so suffering is susceptible of only one solution. The Postal Telegraph is permanently in operation along Pennsylvania lines, so that the only way in which the loss can be made up to Western Union is by a merger of these two companies. Such a merger has often been talked of heretofore, but at the present time appears to have better prospects of being carried out than at any time in the past. It is understood that strong financial interests stand ready to finance the combination whenever details are arranged, but as the project is a big one, quite a little time may elapse before it takes definite shape. That there is room for large economies is clear, since the two systems have been in the most active kind of competition involving the maintenance of two offices in a great many locations where one would suffice."

TELEPHONE MANUFACTURING "TRUST."—A report from Chicago is to the effect that a scheme, which is the preliminary step to the organization of a gigantic telephone trust, which, when its alleged purpose is accomplished, will involve a capital estimated at the amazing sum of $700,000,000, and which will put out of existence all independent telephone manufacturing companies in the country, has come to light in that city. It is alleged that a representative of an Eastern syndicate is endeavoring to obtain options on all independent factories in the city, and that similar options are being sought from all the independent telephone manufacturing companies throughout the country, with the object of forming a big combination of manufacturing telephone interests on about the same order as other large corporations, such as the United States Steel Corporation, in order to eliminate competition in this line. W. J. Hilands, of Chicago, who is said to represent Eastern men in the movement, is reported to have declared that the proposed combination had proceeded so far that there was little doubt about its consummation.

CONEY ISLAND TROLLEY BONDS.—Chairman Dunn and Commissioner Dickey of the State Railroad Commission have heard the petition of the Coney Island & Brooklyn Railroad Company for permission to mortgage its property and franchises for $10,000,000. This, it was stated, would be a consolidated second mortgage, bearing 4 per cent. interest and payable January 1, 1955, to be financed by the Mercantile Trust Company. W. N. Dykman, representing the company, said the bonds would be used to wipe out all outstanding debts, retire a first mortgage of $4,000,000, a $700,000 certificate of indebtedness held by the Equitable Life Assurance Society, and a loan of $240,000 from a local bank. The new bonds would thus become the only lien on the property, and leave $5,000,000 available for improvements. No action has yet been taken.

ANOTHER WIRELESS "DEAL."—The Amalgamated Wireless Securities Company, recently incorporated under Maine laws, and the stock of which is being traded in on the New York curb, has secured control of the American De Forest Company. This company has constructed fifty stations and has 153 in the course of construction or projected. The capital stock of the new company is $10,000,000. The president is Mr. S. S. Bogart, formerly superintendent with the Western Union Telegraph Company; vice-president, Brigadier-General H. H. C. Dunwoody; treasurer, James Dunlop Smith, formerly with Armour & Co.

BROOKLYN RAPID TRANSIT BONDS.—Brooklyn Rapid Transit has sold an additional $7,000,000 of its 4 per cent. convertible bonds, making the amount outstanding $15,000,000. The last bonds, it is understood, were placed with a syndicate at 80 and interest and the proceeds will provide the company with all betterments for 1905.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports received indicate much activity in the manufacturing industries, although distribution is somewhat irregular. Southern trade and collections were checked by the heavy decline in cotton, and in the Southwest, parts of the Northwest and in the Ohio Valley mild weather retarded retail business. Improvement is noted in most lines and in collections at the principal lake cities. As usual at this season of the year wholesale distribution shows a tendency to quietness, although it exceeds that of last year. Railway earnings in November averaged 9.2 per cent. greater than in the same month last year, and the distribution of merchandise is sufficiently heavy to produce freight blockades at several points. Among the industries, iron and steel and the allied lines show most confidence. Some heavy pig iron transactions in the Northern markets are reported, and the volume of orders for finished products is fully in keeping with the previous activity in the crude forms. The present production of iron is close to the maximum capacity. Some hardware manufacturers report that they cannot cover their orders by purchases of billets at present prices, producers being inclined to hold off. Some reaction is shown in the other metals after recent advances, but copper is quite steady, Lake ingot closing at 15. Foreign commerce at the port of New York during the week showed a gain of $2,029,971 in exports as compared with the same week last year, while imports increased $2,008,591. According to *Bradstreet's* there were 231 business failures in the United States during the week ending December 8, as against 184 the week previous and 241 the corresponding week last year.

CONTRACTS FOR 12,000-KW CALIFORNIA PLANT.—The California Gas & Electric Corporation has placed a contract with the Crocker-Wheeler Co. for 12,000 kw of generators to be direct connected to gas engines for installation in its new power plant to be built in San Francisco. At present, power is derived from the corporation's huge hydraulic plant on the Yuba River, 220 miles mistant from the city. It is intended to utilize the new power station as a reserve plant. There will be three alternating current generators, 13,200 volt, 83 r.p.m., 25 cycle, three-phase of 4,000-kw capacity each. These machines will be of the Brown-Boveri type. These generators will be built at the Ampere, N. J., works of the Crocker-Wheeler Co. They will be the largest of their type hitherto contracted for on this side of the Atlantic. The next biggest two of 2,000-kw capacity were lately contracted for with the Crocker-Wheeler Co., by the Huronian Company, which concern—controlled by International Nickel interests—is to install a big hydraulic plant on the Spanish River for transmission to the Canadian Copper Company's property at Copper Cliff, Ontario, Canada. The generators for the Californian Corporation plant will be direct connected to 6,000 hp gas engines—the largest ever built—the contract for which was secured by the Snow Steam Pump Works, of Buffalo, a branch of the International Steam Pump Company. Gas to operate these monster engines will be supplied from the gas plant of the California Corporation.

MORE EQUIPMENT FOR QUEENSLAND.—The Islington shops of the Queensland Government Railways, which are about the largest of their description in Australasia, are to be electrically operated throughout. This decision has been come to largely owing to the success which has attended the installation of electric motive power at the Ipswich shops of the system, where American equipment is being utilized throughout. Manufacturers of electric machinery, machine tools, etc., can look forward to securing some interesting orders shortly. Fully half a million dollars will be expended. Westinghouse electrical equipment is installed in the Ipswich shops and also a member of Niles-Bement-Pond labor-saving devices. The Westinghouse and Niles-Bement-Pond interests in Australasia are taken care of by Noyes Brothers, who are already estimating on the proposed Islington installation.

SOME CROCKER-WHEELER ORDERS.—The Crocker-Wheeler Company has secured a constrat from the Eastern Steel Company, which is to build a big plant at Pottsville, Pa., for two 500-kw, 115 r.p.m., direct-current generators, each to be arranged for direct connection to engines of 750-hp capacity to be built by the Southwark Foundry & Machine Company. A 300-kw Crocker-Wheeler generator has also been ordered for installation in the Youngstown, Ohio, plant of the Republic Iron & Steel Company, and a generator of similar capacity to make 150 r.p.m. will be shipped the Exeter Machine Works at Pittston, Pa. The generator intended for the Exeter plant will be direct connected to an Erie City four-valve engine of 450-hp capacity.

BELGIANS BUY MEXICAN FALLS.—Mexican advices state that the big Zoquitleco waterfall has been acquired by a syndicate of Belgian capitalists who propose to erect a power plant immediately. The purchase price of the property is understood to have been around $400,000. The same syndicate own a number of saw mills and other industrial enterprises in the vicinity, and it is intended to operate these plants electrically.

SWEDISH ELECTRIC COMPANY IN MEXICO.—The Allmainia Svenska Elektriska Aktiebologet (the Swedish General Electric Company) of Verteras, has entered the Mexican field. Mr. Guillermo A. E. Larsen, of Mexico City, has been appointed general representative of the concern in the southern republic. The Swedish company builds both alternating and direct-current generators and motors, etc.

HAWAIIAN HYDRAULIC PLANT.—Advices from the Hawaiian Islands state that a company is in process of organization which has for its object the construction and operation of a good-sized hydraulic plant on the Wainiha River, near Honolulu. Power will be generated for use on sugar plantations and for lighting purposes.

BALL ENGINES FOR PENNSYLVANIA PLANT.—The New York & Pennsylvania Company, of Johnsonburg, Pa., has placed a contract with the Ball Engine Company, of Erie, Pa., for two vertical Corliss compound condensing engines each arranged for direct connection to generators.

EQUIPMENT FOR UNITED LEAD PLANTS.—The United Lead Company, 71 Broadway, controlled by the Guggenheim interests, is to install substantial electric power plants at its Granite City, Ill., and Perth Amboy, N. J., works. The initial capacity of each will be about 500 hp or 1,000 hp in all. Ultimately both plants will have equipments capable of developing 2,000 hp each. At Granite City a 150-hp motor will be used for operating the small rolls in the mill. The white lead plant will use about 450 hp. The shot tower will also be worked electrically. The contract for the boilers—four of 500 hp each—has already been awarded the Aultman & Taylor Co. They will be of Cahall type. The contracts for equipment, etc., are being let by Mr. McGowan, the purchasing agent of the company. His office is at 71 Broadway.

FAILURE OF TURBINE STEAMSHIP.—A cable dispatch from Glasgow, of December 5, says: "The trials of the Allan Line steamship *Victorian* (the largest turbine vessel yet built), which was launched at Belfast, August 25, have been so disappointing as to raise serious doubts among the Clyde shipbuilders as to the value of turbines in the case of large ships. All the efforts made to get the *Victorian* near contract speed were futile, and it is understood that the construction of the turbine engines intended for the new Cunard Line steamers has been suspended pending developments. A sister ship of the *Victorian* will be launched next month. The two vessels were built on the understanding that the new contract for the fast Canadian mail service would be given to the Allan Line." This has been denied, however, as to the alleged failure.

MEXICO CITY LIGHTING CONTRACT.—The Mexican Light & Power Company, Limited, has secured a new contract from the Federal Government of Mexico, for lighting the City of Mexico for a period of ten years. The new contract increases the number of arc lights to 1,200 to burn 4,000 hours annually. The annual sum to be paid the company by the Mexican authorities is $325,777. The old contract was undertaken by the Mexican Electrical Works, Limited, formerly owned by the Siemens & Halske Electric Company, which was purchased some time ago by the Mexican Light & Power Company. The company is authorized under the new contract to generate current from the old Siemens & Halske steam plant, or from its Necaxa hydraulic plant.

ELECTRICITY FOR BLOOMFIELD, N. J., PLANTS.—The Consolidated Safety Pin Company, Bloomfield, N. J., is about to adopt electric transmission and power for its shops. At present, a steam plant is installed. The new system will include a 125-hp generating equipment and about a dozen motors ranging from 3 hp to 20 hp capacity each. Mr. Walter Kidde, White Building, is the engineer-constructor. The Jenkins Manufacturing Company, which makes brass castings across the street from the Consolidated plant, is also to be operated electrically. Power will be taken from the Consolidated plant and several motors will be required. An electric freight elevator will also be put in.

MORE EQUIPMENT FOR NICARAGUA PLANT.—The Central American Commercial Company has been incorporated under the laws of the State of Louisiana with a capital of $1,000,000 for the purpose of effecting a merger of various commercial enterprises in Nicaragua, including that of the Nicaragua Electric Company, which holds an exclusive concession for fifty years to light the city of Managua, (population about 30,000), capital of the Republic. The present equipment includes Bullock generators. The capacity of the plant will be largely increased. Smithers, Nordenholt & Co., of 45 Broadway, represent the new interests.

MOTOR-DRIVEN MINING PUMPS.—C. C. Moore & Co., of San Francisco, Cal., have just closed a contract with the Comstock Mining Company, Nevada, for two pumps, each to have a capacity of 1,650 gallons per minute and a lift of 1,500 ft. The pumps will be driven by two Westinghouse three-phase induction motors, 800 hp each, at 195 r.p.m., and fitted with control devices for starting. To permit of their being installed in position the frames are so split as to allow of their being lowered down a shaft 4 ft. 6 in. by 5 ft. This equipment will, it is said, be the largest of its kind in North America.

30,000-HP MEXICAN POWER PLANT.—Colonel W. C. Greene, president of the Greene Consolidated Copper Mining Company, Blair Building, with his associates, plans to construct large power plants on the Arros River, State of Sonora, Mexico, for the purpose of operating a large smelter and 1,000-ton mill at Dedrick, the gold mines at Mulatto, and also to transmit the current to Nocaza and La Cananea. The transmission lines will aggregate a length of fully 150 miles. In all about 30,000 horsepower will be developed, half of which amount it is proposed to utilize at La Cananea.

ORDERS FOR SILVEY STORAGE BATTERIES.—The Dayton Manufacturing Company, Dayton, Ohio, reports that it has recently closed contracts calling for the following Silvey storage battery installations: Goldberg Brothers' department store, Detroit, Mich.; the Hoover-Prout Co., Avery, Ohio; Dr. E. L. Custer, Dayton, Ohio; William Strop, West Carrollton, Ohio; The Talk-O-Phone Company, Toledo, Ohio; the Wesco Supply Company, St. Louis, Mo. It further reports that its new type R Silvey battery is being very favorably received by the electrical trade.

POWER DEVELOPMENT IN CANADA.—Application is being made to the Dominion Government on behalf of Morrisburg, Ont., for the entire surplus of water power available in the Rapide du Plat Canal, for the purpose of further developing electric power for the use of manufacturing purposes or otherwise as the corporation may deem expedient. W. McLea Walbank, of Montreal, who has been engaged as an expert engineer, has reported that by certain improvements and enlargements upwards of 1,500 additional hp can be had.

LIGHTING OUTFIT FOR CUBAN MINES.—A 75-hp Harrisburg-Fleming side crank engine, to be direct connected to a 50-kw Crocker-Wheeler generator will serve as the lighting equipment for the El Cobre mines, owned by the El Cobre Mining Company, 71 Broadway. The mines are located in the Santiago Province, Cuba. It is expected that further electrical machinery will be purchased shortly for power purposes.

ISOLATED PLANT FOR APARTMENT HOTEL.—Mr. Samuel B. Haines, whose offices are in the Bowling Green Building, is to build a large eleven-story apartment hotel at Sixty-fifth Street and Central Park West in which an electrical plant of about 300-hp capacity will be installed. Mr. Walter Kidde, 126 Liberty Street, will act as consulting engineer and will also carry out the installation work.

BID ON EQUIPMENT FOR PUBLIC LIBRARY.—Mr. Frank Dobson, of 218 East Forty-second Street, has submitted the lowest bid for the heating and ventilating apparatus to be put in the huge Public Library, Fortieth and Forty-second Streets and Sixth Avenue. Mr. A. R. Wolff is the heating engineer, and Pattison Brothers, Flatiron Building, have the electrical work. Mr. Dobson's figures are $299,000.

EQUIPMENT FOR GRAMATAN INN.—The equipment to be installed in the Gramatan Inn to be constructed at Bronxville, N. Y., will include one 150-hp engine, direct connected to a 100-kw generator and two 75-hp engines arranged for direct connection to 50-kw generators. There will also be three motors of various sizes. Pattison Bros., Flatiron Building, are the electrical engineers for the installation.

TURBO-GENERATORS FOR PROVIDENCE MILLS.—The Atlantic Mills Company, of Providence, R. I., in which Mr. A. D. Juillard, of 70 Worth Street, is primarily interested, is to install turbo-generators in its plant. Three 1,000-kw machines will be contracted for the early part of next year. There will also be 2,000 hp of motors ordered.

EQUIPMENT FOR WYOMING APARTMENT.—The equipment to be put in the Wyoming Apartment Company's hotel at Fifty-third Street and Seventh Avenue, New York, will consist of a 350-hp engine, direct connected to a 225-kw generator and about 100 hp of motors. Mr. Clifford J. Potter, of 137 Broadway, is president of the company.

BIDS FOR PUBLIC SCHOOL EQUIPMENT.—Bids will be taken next week for the electrical equipment to be installed in Public School No. 41, to be built at Richard Avenue and Two Hundred and Ninth Street, Bronx. The general contractor is Mr. T. W. Finn, of 163 Columbus Avenue. The architect is Mr. C. B. J. Snyder.

POWER FOR MEXICAN REDUCTION WORKS.—A good-sized electric power plant is to be constructed on the Rio de la Canada, State of Puebla, Mexico, by the Tetela Mining Company, of Tetela de Ocampo, for the purpose of generating power for operating large reduction works to be built in that locality.

CARLOWITZ & CO., No. 15 William Street, New York, having their own houses in China, Japan and Germany, with connections at other foreign points, would like catalogues and export discounts from all manufacturers of products suitable for export.

MOTORS FOR B. H. R. R. OFFICE BUILDING.—Pattison Brothers, Flatiron Building, are about to let a contract for several motors to be installed in the Brooklyn Heights Railroad new office building, Brooklyn.

CONTRACT FOR BROOKLYN BRIDGE POWER HOUSE.—The Thompson-Bonney Co., of 45 York Street, Brooklyn, has secured the contract for the equipment to go in the Brooklyn Bridge power house.

EQUIPMENT FOR SANVILLE ELECTRIC COMPANY.—The Sanville, N. Y., Electric Company is to install a 200-kw generating set. Figures will be taken at the end of the present month.

MOTORS FOR PRINTING PLANT.—Street & Smith, of 238 William Street, will install several motors in a new printing plant which they are to occupy at Seventh Avenue and Fifteenth Street.

General News.

THE TELEPHONE.

FLORENCE, ALA.—The Southern Bell Telephone Company, with a central office at Florence, is extending its system rapidly and will soon cover every important point in this county. Florence already has connection with Waterloo, Smithsonia, Bailey Springs, Rogersville, Sharp's Mills, Oliver, Anderson and Lamb's Ferry and a line is now projected to Cloverdale.

HUNTSVILLE, ALA.—The Inter-County Telephone Company with a paid-in capital of $2000, has been organized. Connection will be made at once with the Bell Telephone Exchange at Huntsville. The stoockholders are all planters residing in the southern part of Madison and Morgan counties, and they propose to increase their capital to $20,000 in a short time and build wires to several other towns in this section. The telephone system will be operated for mutual convenience more than for profit.

LITTLE ROCK, ARK.—The Siloam Springs Telephone Company has been incorporated with a capital stock of $50,000. The incorporators are R. J. Alfrey, Thomas Williams and W. T. Stahl.

LITTLE ROCK, ARK.—Articles of incorporation were filed with the Secretary of State by the Bearden Telephone Company of Bearden, which will construct and operate a local telephone system and construct and operate a line from Bearden to Pine Grove, Dallas County. The capital stock is $2000, of which $1000 has been subscribed. The incorporators are William M. Gatling, president; T. B. Gatling, William M. Gatling, Jr., T. G. Murray, Jeff Gatling, E. J. Byrd, R. J. Gatling, F. H. Lyman, H. W. Jenkins, A. F. Jordan, F. T. Henry and E. A. Fultz.

DENVER, COL.—The Colorado Telephone Company will increase its stock from $5,000,000 to $10,000,000, making additional issues as may be required. For many years the company has spent $1,000,000 a year in improvements and it proposes to capitalize them in the future.

SAVANNAH, GA.—The Georgia Telephone Company will soon begin an extension of its underground conduit and overhead cable lines west of the city.

SPRINGFIELD, ILL.—The Dixon Home Telephone Company, of Jersey City, N. J., has been capitalized in Illinois at $125,000.

SPRINGFIELD, ILL.—The National Telephone & Electric Company of Washington, D. C., has been incorporated in Illinois with a capital of $100,000.

NEW CASTLE, IND.—The Independent and the Bell Telephone companies suffered losses by fire in this city on December 2.

LIBERTY, IND.—A new telephone exchange has been established here by the merging of the Brownsville and the College Point Telephone companies.

LAKETOWN, IND.—The Disco & Laketown Telephone Company has been incorporated with a capital stock of $15,000. The directors are Frank J. Zimmerman, Edwin L. Harmon and Harmon C. John.

MICHIGAN CITY, IND.—The Merchants' Mutual Telephone Company is installing a new switchboard of 2400-line capacity. The increasing demand for service made this improvement necessary. The lines will be greatly extended next spring.

SOUTH BEND, IND.—The South Bend Home Telephone Company is making elaborate preparations for its annual reception, December 31. The exchange will be open for public inspection that evening in celebration of the many improvements the company has made recently. The company has installed 56,000 feet of aerial cable and 20,000 feet of underground cable.

EVANSVILLE, IND.—A recent meeting of the City Council to consider the provisions of the franchise asked for by the Cumberland Telephone Company was largely attended by citizens, who generally oppose the letting thereof. The company offers $100,000 for the franchise, but in instalments of $2250 per year for 45 years. The people are insisting on the price being fixed at $1 for resident telephones and that the company make connection with independent companies.

INDIANAPOLIS, IND.—The New Telephone Company has ordered plans and specifications for the construction of a new exchange building. It is the intention to erect a machinery and switchboard building in the rear of the present building first, and, when completed, the old building will be torn down and a new modern building for offices will be erected on the front of the lot. The contract on this building will be let soon and work is to begin in early spring.

IOWA CITY, IA.—The Solon Telephone Company has been incorporated with $900 capital.

CLIFTON, IA.—The Consolidated Telephone Company has been incorporated with a capital of $50,000.

DES MOINES, IA.—The Winneshiek Co-operative Telephone Company, of Decorah, has been incorporated with a capital stock of $18,000, by L. L. Iverson and others.

NEW ORLEANS, LA.—The Cumberland Telephone Company is constructing toll lines between New Orleans and Shreveport.

BALTIMORE, MD.—Mr. H. W. Webb, general manager of the Maryland Telephone & Telegraph Company, announces that the contracts for the machinery and other equipment of the new electric light and power plant have been awarded and that the work of erecting the buildings on the large lot along the waterfront in South Baltimore is being pushed. The contracts provide for the completion of the plant by July 1 of next year.

FALL RIVER, MASS.—A controlling interest in the Fall River Automatic Telephone Company has changed hands. The purchasers are said to have been John T. Swift and one or two other persons, whose names have been withheld.

SAULT STE. MARIE, MICH.—The Michigan State Telephone Company will rebuild the local system.

ASHLEY, MICH.—The Ashley Improvement Association has taken action toward the building of a telephone exchange at Ashley.

HART, MICH.—The Lake Shore Telephone Company, with headquarters at this town, has installed an automatic system at Pentwater.

ONTONAGON, MICH.—It is proposed to build a telephone line from Ontonagon to the Norwish mine and from there to Matchwood, Bergland, Ewen, Bruces Crossing and possibly Trout Creek. The distance is between 40 and 50 miles and it is figured that the lines could be built for something like $2000.

BATTLE CREEK, MICH.—At the annual meeting of the Citizens' Telephone Company the following-named officers were re-elected for the coming year: President, E. B. Fisher, Grand Rapids; vice-president, L. McCoy, Battle Creek; treasurer, L. W. Robinson, Battle Creek; secretary and general manager, C. E. Tarte, Battle Creek. The affairs of the company are reported to be in excellent condition, and the prospects for the coming year very encouraging.

IRONWOOD, MICH.—The Michigan State Telephone Company proposes to build a line connecting with the Gogebic iron range and do considerable other long-distance work.

LISMORE, MINN.—The Lismore Telephone Company has been formed as a mutual company.

DEXTER, MINN.—The Farmers' Telephone Company is building a new line between Dexter and Brownsdale.

MEDFORD, MINN.—The Straight River Telephone Company has been formed to build a line to Owatonna.

HELENA, MONT.—The Yellowstone Park Telegraph & Telephone Company is securing a franchise to run a line into Butte.

LINCOLN, NEB.—Articles of incorporation have been filed with the Secretary of State by the Jansen Telephone Company. The new company has a capital stock of $10,000 and is incorporated by J. E. Grebe, John Nider, John Bevans, William Gerner, Henry Siebe, Henry Fitte, John A. Friesen, B. F. Knapp, Peter J. Thiesen, D. D. Thiesen, J. G. Friesen, Louis Glebe, D. A. Friesen and Jacob Bartel.

TRENTON, N. J.—The Delaware & Atlantic Telegraph & Telephone Company, Camden, N. J., has filed a certificate of increase of capital stock from $100,000 to $400,000.

ALBANY, N. Y.—The Long Island Central Telephone & Telegraph Company, of Jamaica, has been incorporated with a capital stock of $5000. The directors are E. H. Snedeker, F. N. Greene and T. D. Androcies, of Jamaica.

BOTTINEAU, N. D.—Hon. V. B. Noble will build a telephone line from Granville to Lansford, with possibly a local exchange at Lansford.

HAMILTON, OHIO.—Judge Jones, in the probate court, granted the Independent Telephone Company a franchise in Middleton. A plant will at once be installed by Dayton capitalists.

STAFFORD, OHIO.—The Stafford & Marietta Telephone Company has been incorporated with a capital of $10,000, by George W. Robinson, A. G. Hughes, A. E. Robinson, F. W. Murrey and Earnest H. Robinson.

COLUMBUS, OHIO.—The executive committee of the Ohio Independent Telephone Association met here recently to devise plans for a more compact organization of the independent telephone companies of the State. Those present at the meeting were J. B. Hoge, Cleveland; Dwight E. Sapp, Mt. Vernon; E. L. Barber, Toledo, and Cyrus Huling and Frank L. Beam, Columbus.

YORK CITY, PA.—A meeting of the stockholders of the Pennsylvania Telephone Company will be held at the central office, in Harrisburg, January 25, for the purpose of electing officers. At the same meeting a proposition to increase the capital from $3,000,000 to $5,000,000 will be acted upon. The business of the company has improved so rapidly that further extension is required.

ALTOONA, PA.—A farmers, telephone company, with a capitalization of $10,000, is in process of formation in Frankstown, Catherine and Woodbury townships.

PIERRE, S. D.—The South Dakota Telephone Company has been incorporated with a capital stock of $100,000 to build a line to the Black Hills.

CHATTANOOGA, TENN.—A charter of incorporation has been granted by the Secretary of State to the Consolidated Telephone & Telegraph Company, of Perry County, capitalized at $50,000.

GALVESTON, TEX.—The Home Telephone Company, of Clarkesville, Red River County, has been incorporated with a capital stock of $25,000. The incorporators are John B. King, N. P. Doak and Hiram Glass.

DALLAS, TEX.—It having been determined that no franchise for a new and competitive telephone company at Dallas will be granted, the promoter sprung a surprise on the council by asking for a franchise for a long-distance line and agreed to pay 1 per cent. of the gross receipts for the privilege.

LYNCHBURG, VA.—The fight between the local telephone company and the Southern Bell Company, which has been waged in Lynchburg for ten years, came to an end recently by the purchase by the Bell Company of the franchise and equipment of the home company. The price paid is not stated.

MILWAUKEE, WIS.—The Lone Rock Telephone Company has been formed, capital $150,000. Incorporators: Andrew Harter, George Jamieson and H. Brace.

LANDER, WYO.—A company of Rock Springs capitalists has arranged to build a telephone line from Rock Springs to this city. The local authorities have granted the company a franchise and work on the new line is to be commenced at once. When completed to this point from Rock Springs, the line will probably be extended to nearby towns.

ELECTRIC LIGHT AND POWER.

ATTALLA, ALA.—The Etowah Light & Power Company has been incorporated with a capital of $24,000, by A. L. Du Pre and J. R. Brown, of Attalla and Adolphus Brown, of Ragland.

POCAHONTAS, ARK.—S. C. Dowell, of Walnut Ridge, has secured a franchise for the construction of an electric light plant at Pocahontas.

EUREKA, CAL.—L. F. Puter has petitioned for an electric power franchise. Bids for the same will be received by the Supervisors on Dec. 15.

VISALIA, CAL.—The Mt. Whitney Power Company, of this city, is installing in several of its new sub-stations 8 high-tension Stanley Elec. Manufacturing Company's transformers of 150-kw and 30,000 volts each.

WINSTED, CONN.—Negotiations which have been in progress for some time have been closed by the purchase of the Winsted Gas & Electric Light Company by Frank M. Travis, secretary of the New Haven Gas Company, and his brother, Joseph Travis, of Torrington. The Winsted Company is capitalized for $125,000 and controls the gas and electric lighting in Winsted and owns valuable water privileges. The president is Rufus E. Holmes and the secretary of the company, Henry Skinner.

BUFORD, GA.—Electric light, water and school bonds amounting to $20,000 are reported sold.

BOISE, IDA.—I. B. Perrine is interested in the construction of an electric plant on Trout Creek.

IDAHO FALLS, IDA.—The Idaho Power & Transportation Company has in contemplation the construction of a dam near this city and later the construction of an electric power plant.

POST FALLS, IDA.—The Washington Water Power Company is preparing plans and specifications for a power plant at Post Falls, which will have a total capacity of 18,000-hp. It is reported that the company will soon begin extensive improvements at the plant in Spokane.

MOLINE, ILL.—At the recent annual meeting of the People's Power Company, held at Rock Island, the board of directors was re-elected as follows: A. W. Vanderveer, Davenport; C. H. Deere, Moline; Phil Mitchell, T. B. Davis and S. S. Davis, Rock Island.

MORRISON, ILL.—The Rock River Hydro Electric Milling & Power Company proposes to dam Rock River at Snydon, Ill., and construct a power plant of 1600 to 2500-hp. Work will be commenced in 1905. No engineer has been employed as yet. Stock has been subscribed, but organization has not yet been completed.

DAVENPORT, IA.—The People's Power Company has increased its capitalization from $600,000 to $1,000,000, and has decided on further improvements to its property in the coming year.

SHENANDOAH, IA.—The Shenandoah Electric Light & Power Company has sold its plant, including all the properties of the company, to the Artificial Ice, Power & Light Company. The officers are J. J. Dunnegan, president; Walter P. Crose, secretary; George Bogart, treasurer, and George R. Morse, manager.

LAKE PROVIDENCE, LA.—A. B. Sanders, of Shreveport, has secured the contract for constructing the water works and an electric light plant for $37,000. Arthur Hider, of Greenville, Miss., is the engineer.

DAMARISCOTTA, ME.—The Twin Village Water Company has been granted permission to place electric lights here and in Newcastle.

WATERVILLE, ME.—The Messalonskee Electric Company will petition the new Legislature for authority to organize a corporation to carry on its business.

LEOMINSTER, MASS.—New machinery is being put in the electric light station and extensive improvements are being made.

CANANEA, MEX.—W. C. Greene has taken the preliminary steps toward establishing a large hydro-electric power plant at the junction of the Arros and Yaqui rivers, in the State of Sonora, and to construct transmission lines to Cananea and other places in this section where the power may be utilized in mines and smelters. The distance from the proposed site of the power plant to Cananea is about 80 miles. The plans of Mr. Greene contemplate the development of about 30,000 horse-power.

ANOKA, MINN.—The Anoka Water Works, Electric Light & Power Company will add a new dynamo of 2000 light capacity.

MONTROSE, MISS.—An electric light system is being installed by the Montrose Lumber Company. The service will be extended to business houses.

WHITEFISH, MONT.—Geo. Nixon, of Spokane, Wash., has made surveys for an electric light plant and water works, power to be developed from Hell Roaring Creek. The Big Fork Electric Power & Light Company has secured a franchise for a pole line from Kalispell to Whitefish.

ST. JOSEPH, MO.—The General Electric Company has secured the contract for furnishing the machinery for the municipal electric light plant for $29,712.

EDGAR, NEB.—The City Council has granted a franchise to Keefe & Larkin for lighting the city by electricity. A site has been purchased by these gentlemen for the plant and material for the building is rapidly arriving on the ground.

BRIDGETON, N. J.—The City Council has under consideration the construction of an electric light plant.

JERSEY CITY, N. J.—A resolution requesting all corporations with poles and wires on Newark Avenue, this city, and the business section to place the same underground, has been adopted by the Street and Water Board.

KEARNY, N. J.—Two electrical experts have submitted estimates to the Lighting Committee for a municipal electric light plant. One of the estimates showed that the cost would not exceed $50,000. The other gave the cost at $55,000.

SAYVILLE, L. I., N. Y.—The directors of the Sayville Electric Light Company have decided to purchase and install at once a new dynamo and engine.

WAYNESVILLE, N. C.—The Waynesville Factory Site & Electric Power Company, of Waynesville, has been chartered with an authorized capital of $300,000. It will have the privilege of developing and dealing in electric powers, plants, etc., and to deal in lumber. Silas A. Jones and others are the corporators.

LEXINGTON, OHIO.—H. F. Smith has secured a franchise for an electric light plant.

CANTON, OHIO.—A franchise has been granted to the Citizens' Light, Heat & Power Company to operate in this city.

YOUNGSTOWN, OHIO.—A committee has been appointed with R. D. Campbell as chairman, to investigate the construction of an electric light plant.

McCONNELSVILLE, OHIO.—The McConnelsville-Walta Electric Company has increased its capital stock from $15,000 to $20,000. George S. Corner is president and A. Durbin secretary of the company.

WILKESBARRE, PA.—Chicago capitalists have purchased the Nanticoke Electric Light & Gas Company, the Plymouth Electric Light & Gas Company, the Kingston Gas Company and the Wyoming Electric Light Company.

HARRISBURG, PA.—The Harrisburg Light, Heat & Power Company has secured the contract for furnishing light and power to the new Capitol and all the State buildings, for $26,400 for the year. It is reported that the State will have its own electric light and power plant in a year. An ordinance has been introduced in Council providing for the placing of all wires underground within the city limits.

PHILADELPHIA, PA.—It is stated that the directors of the Keystone Telephone Company have declined the proposition of the Philadelphia Electric Company regarding the purchase by the latter of the telephone conduits. It is further stated that the Keystone Telephone Company will ask Council for the granting of the right to run electric light wires in its conduits. It is reported that the Keystone Company contemplates entering the lighting field.

GEORGETOWN, S. C.—The Georgetown Electric Company has been reorganized, with H. C. Case, of Philadelphia, Pa., president. Extensive improvements are contemplated.

ANDERSON, S. C.—The Piedmont Electric Company, of Anderson, has been chartered by the Secretary of State, capital $25,000. E. S. Moore is president and treasurer, and E. F. Brown, secretary.

SPARTANSBURG, S. C.—Ladshaw & Ladshaw, of Spartansburg, have in hand the contract for a 2000-hp development on the Colorado River at Marble Falls, Tex., the power to be used to drive the machinery for a cotton mill and for lighting purposes.

NEWBERRY, S. C.—The Parr Sholes Power Company, of Newberry County, has been commissioned, with $50,000 capital, to do a general power business. Those interested are M. G. Houseal, C. H. Cannon and K. W. Sligh, of Newberry, and C. L. Scott, of Greenville.

SPEARFISH, S. D.—Electric lights were turned a few nights ago for the first time since the flood in June. The new plant is one of the finest in the State, costing about $50,000.

YANKTON, S. D.—The Yankton Improvement Company has petitioned for a franchise for a gas and electric plant. Isaac Piles and Sanford G. Donaldson are incorporators of the company.

DYER, TENN.—The electric light plant, which was burned here September 11, has been rebuilt and the town is now lighted again.

CLIFTON, TENN.—F. A. Mansfield, proprietor of the ice factory, has decided to construct an electric light plant to light the town.

LAFOLLETTE, TENN.—The question of constructing water works and an electric light plant, at a cost of $100,000, is under consideration here.

MARTIN, TENN.—It is reported that the city officials will at an early date put in a new dynamo and engine at the water and light plant, to supply the town with a day service.

EL PASO, TEX.—The El Paso Gas & Electric Company, of El Paso, has been incorporated with a capital of $500,000. Incorporators: Geo. F. Goodnow, of Waukegan, Ill.; Fletcher S. Heath, Chicago, Ill.; Chas. Bassett, El Paso, and others.

NORTHFIELD, VT.—At a special village meeting it was decided that the municipal electric lighting plant would not be rebuilt, and it was also voted unanimously to contract with Moody & Almon to supply the current for lighting the village.

SPOKANE, WASH.—An electric light plant is to be installed at Gonzaga College.

SPOKANE, WASH.—An agitation is being started in favor of a municipal electric light plant in this city.

NORTH YAKIMA, WASH.—The Northwest Water & Light Company is making preparations to construct a 500-hp plant, 12 miles up the Naches. Robt. Strahorn, Spokane, Wash., is president.

WEST SEATTLE, WASH.—Geo. R. Cooley has prepared preliminary estimates for the construction of an electric light plant. Nothing more will be done until the necessary funds are secured.

BREMERTON, WASH.—Bids will be received Dec. 31 by Mordecai T. Endicott, Chief of Bureau of Yards and Docks, for furnishing a 40-ton electric traveling crane in building No. 108, Navy Yard, Puget Sound.

CADOTT, WIS.—The Cadott Lighting & Manufacturing Company is stated to have purchased the plant of the Cadott Manufacturing Company. The company will put in a new alternating system and improve the plant. A new power house will be constructed on Yellow River.

THE ELECTRIC RAILWAY.

CHICO, CAL.—The Chico Electric Railway Company, now building lines here, has entered into a contract with the Valley Counties Power Company for power for a term of 20 years. The sub-station of the company will be located at Barber, Cal., where the 15,000-volt, 60-cycle, three-phase current will be transformed. The company plans to extend its line to Oroville next year. This will make a total of 30 miles of single track.

WASHINGTON, D. C.—The Auto-Transit Company, of this city, has applied to the Commissioners for permission to operate an electric vehicle over a "regular route" in the city of Washington. The vehicle, for which a permit is asked, has a capacity of eighteen persons, and it is understood that it is proposed by the company to place the electric car on 16th Street, to operate as one of a line of electric herdics which it is proposed to place in operation within a short time.

ATLANTA, GA.—The Atlanta & Carolina Railway Company has been formally organized here to build an electric railway to Greenville, S. C., from Atlanta. The capital stock has been raised from $50,000 to $2,000,000. John R. Hosch has been elected president, M. T. Edgerton, secretary, and Jos. A. McCord, of Atlanta, treasurer. The company has right of way, it is understood, in a number of counties, and to Anderson, S. C.

CHICAGO, ILL.—It is reported that the directors of the underlying north and west side companies of Union Traction will begin court proceedings shortly to attempt to recover control of their lines and force a dissolution of Union Traction.

INDIANAPOLIS, IND.—The Interstate Traction Company has been incorporated with a capital stock of $150,000, by John C. Curtis, of Portland, John H. Painter and others.

INDIANAPOLIS, IND.—The Indianapolis, New Castle & Toledo electric railway has been chartered. Capital, $3,500,000. Incorporators: D. N. Parry, W. E. Stevenson, E. Marvin and others.

MARION, IND.—The Marion & Eastern Traction Company has filed articles of incorporation with an initial capital stock of $30,000. The principal office will be in Marion. R. E. Breed, William B. Dodds, J. J. Colman and others are the promoters.

INDIANAPOLIS, IND.—The capacity of the power house of the Indianapolis & Eastern Traction Company, at Philadelphia, Ind., has been increased by the addition of an 1800-hp Hamilton-Corliss cross-compound engine, direct connected to a 1000-kw Bullock generator.

CONNERSVILLE, IND.—Local capitalists are promoting an electric railway from this city to Cambridge City, a distance of 20 miles. The plan is to lease the old L. E. & W. road between Milton and Beeson, connecting with the electric railway between Milton and Cambridge City, now operating. This would leave only 5 miles of track to be built to complete the road.

VINTON, IA.—An electric railway has been projected from Vinton to Belle Plaine.

IOWA CITY, IA.—The Iowa City-Davenport Interurban Railway Company will seek a franchise in this city.

BURLINGTON, IA.—An electric railway is to be built which will connect Des Moines and Woodward. It will cost $500,000.

DES MOINES, IA.—The engineers of the Des Moines Interurban Railway Company are in the field surveying a new line to Winterset.

CUMBERLAND, MD.—A charter has been granted the Keyser-Burlington & Pittsburg Electric Railroad Company, of Keyser, to build from Keyser, Mineral County, to Petersburg, Grant County. The company is capitalized at $600,000. Incorporators: Archibald C. Willison, Abraham P. Gross, T. R. Palmer, John S. Siebert, B. W. Wright and W. G. Call, all of Cumberland.

WARREN, MASS.—There is an agitation among business men in Warren in favor of a street railway from that town to Stafford Springs, Conn., passing through Brimfield and Wales.

GARDNER, MASS.—The property of the Templeton Street Railway is advertised for sale December 10, at a sheriff's sale.

BOSTON, MASS.—The Railroad Commissioners have authorized the Boston & Worcester Street Railway Company to issue $160,000 4½ per cent. twenty-year bonds. The issue is for the purpose of double-tracking the road.

ATTLEBORO, MASS.—John T. Burnett and John L. Hall, receivers of the Bristol County Street Railway Company, announce that they propose to sell on December 17 all the property, locations, franchises and assets of the road. The sale will take place in the Attleboro office. The sale is pursuant to a decree made and entered by the General Court of the United States for the District of Massachusetts, in an action of equity entitled "Pacific Surety Company vs. Bristol County Street Railway Company." The property is to be disposed of in two parcels. The first parcel includes rights of way, real leasehold estates, engines, cars, rolling stock, dynamos, booster, Hatch accumulator, poles, wires, equipment, machinery, implements, stock, furniture, supplies and documents. It is sold subject to a first mortgage given January 5, 1901, to the Federal Trust Company, of Boston, to secure an authorized issue of $250,000 first mortgage bonds, of which $200,000 were issued and are now outstanding. The second parcel consists of six passenger cars. The receivers state that they will not accept any bid less than $30,000, and that all bidders must deposit a check for $500. One of the franchises which will be sold is a right of way through Seekonk to Providence. This, it is thought, is an asset that will be valuable in the future.

ANN ARBOR, MICH.—The Adrian & Ann Arbor Electric Railway Company has applied to the Council for a franchise.

STILLWATER, MINN.—The Twin City Rapid Transit Company has applied for a franchise for a line between this city and South Stillwater.

HOUSTON, MO.—The Houston, Licking & Salem Electric Railway Company has been organized with the following board of directors: James A. Craven, Robert Lamar, W. J. McGehee, Clark Dooley, W. E. Barton, J. R. Blankenship and A. J. Johnston. Bonds will be issued soon and placed on the market. The plan of the company is to build an electric railway from Houston to Salem via Licking.

ITHACA, N. Y.—E. B. Kay, of Ithaca, and New York capitalists, are making preliminary plans for an electric railway from Ithaca to Elmira.

ALBANY, N. Y.—It is rumored here that the United Traction Company, operating in Albany, Troy, Rensselaer, Watervliet, Waterford and Cohoes, may be absorbed by New York Central Railroad interests.

NEW YORK, N. Y.—The contest between the Rapid Transit Commission and the Interborough Rapid Transit Company over the latter's right to display advertising promiscuously in the subway stations is likely to be taken to court for settlement.

SCHENECTADY, N. Y.—The 3 miles of additional third-rail track between Schenectady and Hoffmans has been completed, and tests of the electric locomotives for the New York Central Railroad's suburban service are to be made during the winter.

OGDENSBURG, N. Y.—There is a movement on foot to reorganize the Ogdensburg Power & Light Company and the Ogdensburg Street Railway Company. The syndicate of banks which financed these properties has selected E. E. Hawkins, of Narragansett Pier, as manager.

SYRACUSE, N. Y.—A party of surveyors has begun work for a new trolley road extending from the Jamesville terminus of the Syracuse & Suburban road through to Pompey and Fabius. C. A. Petrie, of Elmira, is behind the enterprise, and plenty of capital is at hand. The movement is being aided by general manager Charles E. Hubbell, of the Syracuse & Suburban road.

LONG ISLAND CITY, N. Y.—The sub-station of the New York & Queens County Railway Company in Flushing has been completed and put in operation. Power for the lines betweeen Flushing and Jamaica, Flushing and College Point and the easterly end of Jackson Avenue, in Newtown, is transmitted to the new station from the power house in Long Island City at about 6000 volts alternating.

RALEIGH, N. C.—The Raleigh-Durham Passenger & Power Company has been chartered by the Secretary of State for the purpose of constructing an electric railway from Raleigh to Durham, 28 miles, and to build two belt lines in Raleigh; also power and light plants for the two cities. W. J. Nelms, who established the Newport News-Old Point system in Virginia, is one of the principal incorporators.

TOLEDO, OHIO.—The Toledo, Port Clinton & Lakeside Railway, which is now operating its line by a temporary power station at Genoa, is having plans prepared, and will shortly place contracts for a large permanent power station. The road will be extended to Lakeside next summer.

CLEVELAND, OHIO.—J. V. Ward, promoter of the Cleveland, Canton & Canal Dover Electric Railway, claims that English capitalists have agreed to furnish money to build the road. He says the line will extend from Cleveland to Canal Dover by way of Canton with branches to Ravenna, Alliance, Carrollton, Mineral City, Youngstown and many smaller places, the entire system embracing about 96 miles of road. It is proposed to construct the line wholly on a private right of way and to use the third-rail system.

STEUBENVILLE, OHIO.—The Commissioners of Jefferson County have granted L. W. Healy and others of the East Liverpool Railway Company a franchise to build a road from Empire to the Jefferson County line. From East Liverpool the Healy lines will be built to Beaver, and the entire distance between Wheeling and Pittsburg will be spanned. There is now a completed line from Wheeling to Empire, a distance of 38 miles. To the county line is 5 miles, and from that point to Smiths Ferry, Pa., 12 miles, the East Liverpool line is in operation. The system will be 90 miles long.

UNIONTOWN, PA.—Surveys have been commenced for the electric railway to connect Uniontown with Brownsville.

SOUDERTON, PA.—All rights of way have now been secured for the Souderton, Skippack & Fallview Electric Railway, and the stockholders will increase the capitalization from $100,000 to $300,000, with a bonded indebtedness of $500,000. The road will be built next spring.

CHAMBERSBURG, PA.—It is reported that the Hagerstown Electric Railway Company is considering the building of a further extension of its lines from Boarsboro to Sharpsburg, via Keedysville and Antietam battlefield, a distance of about 6 miles. The company has temporarily abandoned the project of building the 2-mile branch from Myersville to Black Rock on account of the great expense.

CHARLESTON, S. C.—The Charleston & Summerville Railway Company, of South Carolina, with a capital of $1,000,000, has been chartered to build an electric railway between the points named. J. J. O'Connor, George S. Legare and others are interested. In addition, the State has also commissioned the Charleston & Summerville Electric Railway Company, in which A. J. Warner, of Gainesville, Ga., is interested. While it is stated that the last-named concern will go to work on its plans at once, the first-named has not announced its future plans.

HOUSTON, TEX.—The Houston-Galveston Interurban Railway Company has filed another amendment to its charter, increasing the capital stock from $500,000 to $1,000,000. The plan of the company is to build a line from Houston to Galveston.

MARYSVILLE, B. C.—Application is being made for a charter to build an electric railway here. Jas. Finley and Francis Jas. Weeks, of Marysville, are reported interested.

BRANTFORD, ONT.—An electric railway betweeen Brantford and Hamilton seems to be assured. The route is now being surveyed and construction will be commenced early next spring. J. K. Leslie, of Toronto, is one of the promoters.

NEW INDUSTRIAL COMPANIES.

THE ELECTRIC BUILDING COMPANY, of Alliance, Ohio, has been incorporated with a capital stock of $15,000. The incorporators are F. S. McGowan, E. S. Cook, A. T. Brewer and others.

THE PARK AUTOMOBILE COMPANY, with a capital stock of $10,000, half paid, has been incorporated at St. Louis, Mo., by Alexander T. Primm, Jr., Samuel S. Primm and Chas. E. L. Thomas.

THE TROY PLATE BATTERY COMPANY, of Binghamton, N. Y., has been incorporated with a capital stock of $50,000. The directors are E. A. Beman, A. C. Rohe and G. C. Bayless, of Binghamton.

THE CAPEN MOTOR CAR COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $15,000, one-half paid. The incorporators are Samuel D. Capen, George A. Capen and Wallace G. Capen.

THE AUTO GARAGE ELECTRIC CONSTRUCTION COMPANY, of Zanesville, Ohio, has been incorporated with a capital stock of $5000. The incorporators are C. A. Rosa, J. Rhodes, E. F. Triplett and others.

THE DE MARS ELECTRIC VEHICLE COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $25,000 The incorporators are William O. De Mars, Charles Wilson Baker, John R. Blakeslee and others.

THE ARC LIGHT DISTRIBUTER & LANTERN COMPANY, of New York City, has been incorporated with a capital stock of $2000. The directors are Lillian A. Bleiman, H. J. Palmer and Adelaide Robinson, of New York.

THE CENTRAL CHANDELIER COMPANY has been incorporated at Chicago, with a capital of $2500, for manufacturing lighting apparatus and fixtures. The incorporators are G. Schwarting, L. A. Schwarting and P. R. Mowery.

THE BARKELEW ELECTRIC MANUFACTURING COMPANY, of Middletown, Ohio, has been incorporated with a capital stock of $15,000, by C. H. Barkelew, C. S. Barkelew, M. T. Barkelew, E. W. Barkelew and G. D. Lammis.

THE INDIANA SCHOOL OF TELEGRAPHY, with headquarters in Goshen, Ind., has been incorporated with a capital stock of $10,000. C. S. Rhodes, superintendent of telegraph of the Big Four, and J. E. Neusbaum are interested.

THE WILLIAM McGONIGAL COMPANY, of Mount Vernon, N. Y., has been incorporated with a capital stock of $20,000. The directors of the company are William McGonigal, Clarence Fountain and Madge Fountain, of Mount Vernon.

THE UNION AUTOMOBILE MANUFACTURING COMPANY, of St. Louis, Mo., has filed articles of incorporation with a capital stock of $12,000, full paid. The incorporators are Benjamin B. Hulbert, Geo. H. Martin and Geo. B. Louderback.

THE PIERCE SPECIALTY COMPANY, Chicago, Ill., has been incorporated with a capital of $50,000. The company of which the incorporators are E. J. Finn, Mary Mulcahey and M. J. Thompson, will manufacture electric and other specialties.

THE SELECTIVE TELEPHONE COMPANY has been incorporated at Jersey City, N. J., to manufacture and deal in selective telephone apparatus, with a capital stock of $200,000. The incorporators are John J. Mara, W. S. Davis, James R. Carroll and Le Roy S. Lewis.

LEGAL.

FREE CAR TRANSFERS.—By a decision of the New York State Court of Appeals, the Interurban and the Brooklyn Rapid Transit systems of street railways will be required to give transfers to points on any of two lines which they operate in the City of New York. The opinion of the court, however, restricts the number of actions that can be brought for the recovery of penalties. It says that "a sound public policy requires that only one penalty should be recovered in a single action, and that the institution of an action for a penalty is to be regarded as a waiver of all previous penalties incurred." The penalty for a failure to give transfers is $50 for each refusal, and some persons have brought actions for accumulated penalties aggregating several thousand dollars. This decision permits them to recover only one penalty at a time and denies them the right of obtaining accumulated penalties.

PERSONAL.

MR. RAMON VALDES, who operates an electric lighting plant in San Juan, has returned to New York from a short visit to Porto Rico.

MR. NIKOLA TESLA is the subject of portraiture and biography in the calendar of the Bullock Electric Company for December. He was born in 1857.

MR. ROBERT FLEMING, of London, is now on a visit to this side. He represents considerable British capital which is invested in various American electrical enterprises. At present he is at the Waldorf-Astoria.

MR. WALLACE C. JOHNSON, C. E., of Niagara Falls, N. Y., consulting engineer for water power transmission, etc., has been appointed by Governor Odell the engineer member of the River Improvement Commission.

MR. J. H. PERKINS, general superintendent of the Youngstown Consolidated Gas & Electric Light Company, will make a change on January 1, 1905, becoming general manager of the Wilkesbarre Gas & Electric Company, of Wilkesbarre, Pa.

MR. J. D. ROCKEFELLER.—John D. Rockefeller has presented between $2,000,000 and $3,000,000 as a Christmas gift to the University of Chicago. The money, it is understood, is to be used for the creation of a school of engineering at the university.

MR. P. G. GOSSLER, vice-president of J. G. White & Company, New York City, has returned from Porto Rico, where he recently went for the purpose of inspecting the property of the San Juan Light & Transit Company, of which concern he is now president.

MR. CALVERT TOWNLEY, until recently New York general sales manager of the Westinghouse Electric & Mfg. Company, has entered the service of the New York, New Haven & Hartford Railroad and will, as assistant to President Mellen, have direct charge of all of its electrical interests.

MR. J. W. McCROSKY, who was at one time one of the engineering experts attached to Mr. Theodore N. Vail's South American electric traction interests, and who is now on the engineering staff of J. G. White & Company, Ltd., of London, has sailed for Europe, after making a special trip to South America for the White interests.

MR. ALEX. O. HAEFTMANN, who has held for the past eleven years the position of superintendent of the electrical cable works of the American Steel & Wire Company, of Worcester, Mass., formerly Washburn & Moen Company, has resigned to accept a position in the manager's department, to take care of the electrical and commercial end of the same business.

DR. R. S. WOODWARD.—Dr. R. S. Woodward, Dean of the School of Pure Science of Columbia University, New York City, has been elected President of the Carnegie Institution by the Board of Trustees. He will succeed Dr. D. C. Gilman, the ex-President of Johns Hopkins University, who has resigned. Dr. Woodward is well known as an educator and scientist, and was connected successively with the Coast and Geodetic Survey and the Geological Survey.

MR. JOHN BACKER, of the firm of Backer & Company, of Santiago, Chili, is in New York for a short time making an investigation of American electrical apparatus that might be useful to companies in his city and country. Mr. Backer is interested in securing circular and catalogue information concerning electrical manufactures, and desires to be furnished with price-lists. Mail matter addressed to Post Office Box No. 12, New York City, will reach him during December and January.

MR. CHAS. H. TUCKER, late active designer and assistant chief engineer with Pawling & Harnischfeger, of Milwaukee, has accepted the position of chief engineer with the Case Manufacturing Company, Columbus, Ohio, engineers, designers and builders of cranes and special machinery. This is in keeping with the progressive policy of the Case Manufacturing Company and its largely increased output. Mr. Tucker has been associated with the crane business since its infancy and is widely known as one of the ablest engineers in this field.

MR. W. J. SANDO has been appointed manager of the Allis-Chalmers Company's pumping machinery department, with headquarters in Milwaukee. Mr. Sando was born in Scranton, Pa., in 1864, and after completing the public school course, served an apprenticeship of five years as a machinist in the works of the Dixon Manufacturing Company of that city. He then served another apprenticeship of two years in the drafting room, and in 1886 became draughtsman and inspector of pumping machinery for Mr. E. D. Leavitt, of Cambridgeport, Mass., with whom he remained until 1887, with the exception of a short period during which he was draughtsman in charge in the naval engineer's office at Cramp's shipyard. Since then he has occupied positions of inspector of pumping machinery and mechanical engineer in charge of pumping stations of the Boston Metropolitan Water Board, chief engineer of the International Steam Pump Company and engineer in charge of the Pumping Department of the New York City Commission on Additional Water Supply.

MR. C. C. LEWIS, who for the last two years has occupied the position of chief engineer of the Schenectady Railway Company, will sever his connection with that company on January 1, 1905, when he will sail for London to enter the employ of J. G. White & Company, Ltd. Mr. Lewis has been engaged principally to take charge of the work to be carried out by J. G. White & Company, Ltd., at Montevideo, Uruguay, this company having recently secured the contract to electrify the tramways at that place. Mr. Lewis has had an extended experience of over 15 years in railway work, having been connected with the Broadway cable work, afterward in Baltimore converting the lines of the Baltimore City passenger railway from horse to cable, in Washington on the electric conduit work of the Metropolitan lines, and in Buffalo as engineer of the International Railway Company, where he had charge of construction work involving the expenditure of between $3,000,000 and $4,000,000. In 1902 Mr. Lewis accepted the position as chief engineer of the Schenectady Railway Company, having charge of the construction and maintenance of the tracks, buildings, overhead and mechanical and electrical equipment, as well as the rebuilding of the electric line between Schenectady and Albany, and the construction of the Troy and Ballston line, which has recently been equipped for the operation by both the direct current and the new single phase alternating current systems.

OBITUARY.

MR. E. T. HOLMES has lost his mother, Mrs. Eliza A. Holmes, widow of Edwin Holmes, founder of the Holmes Electric Protective Company, who died on December 11, at the home of her daughter, Mrs. A. S. March, Orange, N. J., 82 years of age. Mrs. Holmes had been a resident of Brooklyn and New York for 45 years. She leaves one son, Edwin T. Holmes, president of the Holmes Electric Protective Company, and two daughters, Mrs. J. Stuart White and Mrs. A. S. March.

MR. A. C. WARD.—Albert Cooper Ward, son of Mr. G. G. Ward, vice president of the Commercial Cable Company, died at his father's home, in New York City, Friday, Dec. 9, of pneumonia, after an illness of only 24 hours. Deceased was 23 years of age and was graduated from the Sheffield Scientific School, Yale University, this year. He was a member of the brokerage firm of Keen & Ward, and was engaged to be married to Miss Beatrice Squire, of Greenwich, Conn. The funeral was held on Sunday, Dec. 11. The many friends of Mr. G. G. Ward sympathize with the family in their bereavement.

Trade Notes.

THE CRESCENT COMPANY, Chicago, has just issued a new bulletin of the Crescent lamp coloring and frosting. It is described as "the kind that won't come off," and certainly fills a long-felt want in this line of material.

THE COOPER HEWITT ELECTRIC COMPANY, of New York City, has opened a branch office at Philadelphia, in charge of Mr. Eugene D. Hays. An attractive display of the company's specialties for photographic and other work has been installed, and it is proving of great interest to a large number of visitors.

"REFLECTRIC."—The Western Display Company, St. Paul, Minn., in a recent booklet sets forth illustrations of many styles of its "Reflectric" signs. These devices, as is well-known, show up the lettering equally well by day or night. They seem to be meeting with much favor as they are seen everywhere.

CRANES.—In booklet No. 19, just issued by the Northern Engineering Works, Detroit, Mich., are described in condensed form a few of the many types of electric cranes manufactured by this well-known concern. The booklet has 28 pages, 26 of which are illustrated with views of cranes of different types and styles, including traveling cranes, pillar cranes, locomotive cranes, jib cranes, etc. A copy of this interesting booklet can be obtained by addressing the company.

THE GOULDS TRIPLEX FEED PUMP, operated by a 40-hp electric motor, located in the boiler house of Machinery Hall at the World's Fair, St. Louis, has been purchased by the Lewis and Clark Exposition Company, to be used for the same purpose at its Exposition to be held at Portland, Ore., next year. The Goulds Mfg. Company, of Seneca Falls, N. Y., was awarded a gold medal for this pump which supplied feed water for boilers of 4000 horse-power in the boiler house that furnished the power for Machinery Hall. The Goulds Company was awarded three other gold medals, one for its exhibit in Machinery Hall of power pumps and one each for its exhibits of hand pumps and sprayers and spray fittings, in Horticultural Hall.

FIELD RHEOSTAT CATALOGUE.—A new field rheostat catalogue has been issued by the Ward Leonard Electric Company, of Bronxville, N. Y., its bulletin No. 19,049. This catalogue covers field rheostats suitable for every geenrator from 2000-kw down to ½-kw, and of any voltage from 65 up to 600 volts. The pamphlet states that all rheostats catalogued therein are carried in stock at all times. In this catalogue dimension sheets and drilling tables are carefully shown. The list prices have not been changed. The company's reference to its discount sheet shows the net selling price to have been materially reduced. When the price of such a standard and a proven electrical necessity is reduced, the whole electrical fraternity is benefitted.

COOPER HEWITT LAMP.—The Cooper Hewitt Electric Company in a 26-page catalogue describes and illustrates the various commercial forms of the Cooper Hewitt vapor lamp. Views show installations of the lamp for the lighting of a large storage battery room, a warehouse, a steamship pier and machine shop. Other views show equipments for lighting photographic studios, for blue printing and for photographic processes. In considering the matter of efficiency, a quotation is given from an article by Professor Geer, printed in the *Physical Review*, showing that the efficiency of the Cooper Hewitt lamp varied from 40 to 47 per cent., as against 10 per cent. for the arc light, 6 per cent. for the incandescent lamp and 1.61 for the argand gas burner.

WESTINGHOUSE DIRECT CURRENT MOTORS.—The Westinghouse Electric & Manufacturing Company is prepared to furnish electrical equipments for printing and publishing establishments. The company has full data and information concerning these trades and their requirements in regard to electrical equipment and has made a careful and systematic study, not only of the mechanical and electrical requirements, but also of the problem from the commercial point of view, thus enabling it to recommend and install systems which show the greatest returns on the investment. The company has just issued a pamphlet describing its Type S motors, and many illustrations show the application of these machines to various classes of work, such as driving of folders, machine tools, etc. These motors are designed for direct currents. One of the illustrations shows a motor with vertical shaft.

THE DEANE STEAM PUMP COMPANY, of Holyoke, Mass., is distributing a new catalogue on condensers, No. D-23. This publication reviews the principles and advantages of the several types of condensers as applied to steam engines, including surface and jet condensers, and discusses, also, vacuum pumps, exhausters, air and circulating pumps and other auxiliaries. A recent development, which is treated of quite fully, is the provision of proper condensing arrangements for steam turbines. Unlike the reciprocating engine, the turbine can expand its steam to the extreme limit of the exhaust pressure and every inch of vacuum above 26 inches increases the economy by from three to five per cent. It is therefore advantageous to use the most perfect type of condensing equipment for this service, which has led to the production of improved types of independent air and hot-well pumps, separate circulating pumps, air coolers, etc. Everyone having to do with steam power plants will find this book of value.

ELECTRIC LIGHT OUTFITS.—The Richardson Engineering Company, Hartford, Conn., has issued a very comprehensive catalogue of its complete electric light outfits for launches, yachts, houseboats, private residences, cottages, farms, clubs, hotels and shops. The introduction consists of a very practical discussion of the advantages of electric lighting in the lines above mentioned, and is followed by a complete description of the various outfits designed for these special purposes. The outfits vary in size from 4 lights up to 60 lights, and many of them are illustrated. Other illustrations show the component parts of these outfits, such as the gas engines, switchboards, dynamos, storage batteries, etc., besides many accessories, including lamps, headlights, etc. The company also manufactures steam-driven outfits of 20 and 40 lights capacity and larger gas-driven outfits than those above referred to. The catalogue is a very complete exposition of the general subject and will be a valuable aid to those contemplating the installation of a small plant.

ENGRAVING MACHINE.—A device that will be found extremely useful in work shops is the engraving machine manufactured by the George Gorton Machine Company, Racine, Wis. It is used for cutting letters or designs, either sunk or in relief, on metals and other materials and for work on moulds, dies, etc. Each machine is capable of producing letters from 3-in. in height down to lettering so fine as to be unreadable without the aid of a magnifying glass, thus showing the wide range of work. It is stated that the machine will work on almost any form of surface, and on any material that can be cut. The graver is a vertical revolving drill or cutter which the operator guides in its work by traversing a style, by hand, along the lines of the copy. In a catalogue issued by the company many examples of machine engraving are shown, and the wide range of the work possible is astonishing. These machines should find a large field of use in electrical manufacturing concerns, where metal parts are to be marked, numbered or lettered. It is stated that no skilled help is required for the operation of this machine, and that the work is better and more rapidly accomplished than hand work by a skilled engraver, besides being cheaper.

MR. FRANK B. COOK, besides getting an order for 8000 pairs of his No. 444 protector from the Citizens' Telephone Company, of Columbus, Ohio, has received the following orders for this popular type of self-soldering protectors: LaHarpe Telephone Company, LaHarpe, Ill., 200 pairs; United Tel. & Tel. Co., for exchanges at Newport, Pa., a type L-3 frame of 100 pairs capacity, equipped with 50 pairs; for their Littletown, Pa., exchange, type L-3 frame of 100 pairs capacity equipped with 50 pairs; Mangum Telephone Company, Mangum, O. T., type L frame, 300 pairs capacity, equipped with 260 pairs; Suburban Telephone Company, Ferguson, Mo., an addition of 60 pairs; E. Ritter, Marked Tree, Ark., 100 pairs; Kellogg Switchboard & Supply Company for the telephone exchange at Freeburg, Ill., 100 pairs; Scott Company telephone system, Oran, Mo., type L-3 frame, 100 pairs capacity, equipped with 60 pairs; North Eastern Telephone Company, an addition to the Lewiston, Me., Exchange, 150 pairs No. 444. Mr. Cook has also received an order from the Eastern Telephone Mfg. Company for the exchange it is installing at Union, N. Y., for the York State Telephone Company. This order was for a type L frame of 300 capacity, equipped with 60 pairs.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 6, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

776,491. TEMPERATURE COMPENSATING DEVICE FOR ELECTRICAL MEASURING INSTRUMENTS; William H. Bristol, Hoboken, N. J. App. filed Feb. 23, 1904. A temperature compensating device located in proximity to the measuring instrument and containing a mercury column acting on a resistance in series in the circuit for automatically maintaining constant the total resistance of a part of the circuit containing the measuring instrument and the compensating device under variations in temperature.

776,514. CLEAT FOR ELECTRIC WIRING; Emory C. Hunt, Belle Plaine, Ia. App. filed Jan. 26, 1904. A base and cap, the former having a wedge-shaped bore through which the fastening screw can be passed either straight or oblique as circumstances may require.

776,521. ELECTRIC SWITCH; Walter S. Levin, New York, N. Y. App. filed March 28, 1904. Details.

776,522. ELECTRIC SWITCH; George B. Low, Newton Center, Mass. App. filed May 23, 1904. Details.

776,524. AUTOMATIC TELEPHONE EXCHANGE; Frank A. Lundquist, Chicago, Ill. App. filed April 30, 1900.

776,526. ELECTRIC BRAKE FOR VEHICLES; Joseph N. Mahoney, Brooklyn, N. Y. App. filed Jan. 21, 1904. Electro-magnetic brake apparatus is included in the armature circuit of the motors to be actuated by current generated by the motors when they are driven by the momentum of the car; a special circuit includes the field of the motor and the current in this circuit is automatically varied as the speed of the vehicle varies, to control the current in the brake apparatus.

776,534. MEANS FOR AUTOMATICALLY STOPPING RAILWAY CARS OR TRAINS; William O. Mundy, Louisville, Ky. App. filed Sept. 30, 1902. A pivoted arm is mechanically connected with signal-operating mechanism so that a main switch in the car circuit will be struck in case the car runs beyond the danger signal.

776,536. SELF-CLOSING TELEGRAPH KEY; Noble S. McKinsey and Anton R. Nelson, Susanville, Cal. App. filed Dec. 26, 1903. A plunger attached to the lever holds the circuit closed whenever the key is out of operation.

776,545. SWITCH; Edwin F. Porter, Boston, Mass. App. filed March 30, 1903. A motor compressor is stopped and started by two buckling diaphragms subjected to the air pressure and actuating an electric switch.

776,546. BRUSH HOLDER; Edward D. Priest, Schenectady, N. Y. App. filed April 19, 1902. A brush holder having sockets for two brushes, a separate follower for each brush and a single spring acting on both followers.

776,556. CONDUIT FOR ELECTRIC WIRES; Clarence C. Sibley, Perth Amboy, N. J., and George A. Lutz, New York, N. Y. App. filed Dec. 19, 1902. A metallic conduit having star-shaped slits at intervals through which fastening screws may be forced; the tongues formed by the slits remain closed wherever the screw is omitted.

776,557. ELECTRIC TRANSMISSION MECHANISM; Charles G. Simonds, Schenectady, N. Y. App. filed May 5, 1904. A shaft and two dynamos

having their armatures mounted theereon, the fields being movable relatively to each other and to the shaft and each field having a web extending around its armature and forming a bearing for the shaft between the armatures.

776,563. CURRENT RECTIFIER; Percy H. Thomas, Pittsburg, Pa. App. filed Feb. 4, 1903. (See page 1058.)

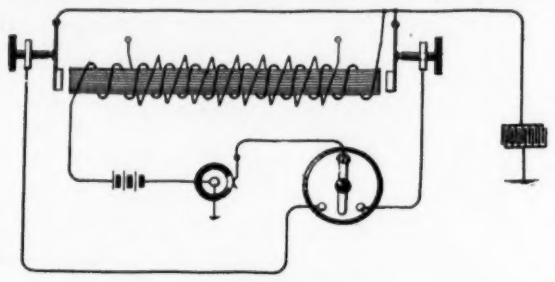
776,564. CURRENT RECTIFIER; Percy H. Thomas, Pittsburg, Pa. App. filed Feb. 4, 1903. (See page 1058.)

776,565. CURRENT RECTIFIER; Percy H. Thomas, East Orange, N. J. App. filed May 6, 1903. (See page 1058.)

776,622. RESONATOR; John F. Skirrow, East Orange, N. J. App. filed June 23, 1903. A sounding box for a telegraph sounder, mounted on a suitable swinging standard.

776,638. PORTABLE ELECTRIC DEVICE; Charles E. Avery, Jersey City, N. J. App. filed April 18, 1904. A circuit closer for flash lamps comprising a spring conducting arm and a resilient tongue carried thereby; a lever pivoted to the arm is used to force the tongue into contact with one pole of the battery.

776,653. WINDING FOR ELECTRICAL APPARATUS; Joseph W. Farley, East Pittsburg, Pa. App. filed March 16, 1904. Two similarly wound



776,705.—Induction Coil.

sections each composed of a plurality of suitably insulated strands, arranged one outside of another, the strands of one section being joined to those of the other section in reverse order so that the longer and the shorter strands are connected to form turns of uniform length.

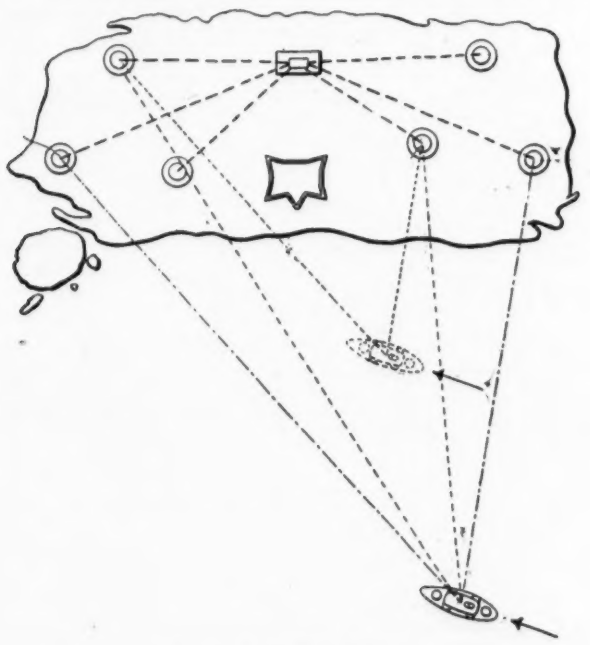
776,654. COIL FOR ELECTRICAL APPARATUS; Joseph W. Farley, East Pittsburg, Pa. App. filed March 16, 1904. A modification of the preceding patent.

776,660. ELECTRIC FUSE AND CUT-OUT; Benjamin H. Glover, Buffalo, N. Y. App. filed Aug. 13, 1903. A sheet of paper having powdered refractory material on its face, is rolled up with the fuse at the axis; the layers of paper and powdered material choke the discharge.

776,681. ELECTRIC RAILWAY; Richard C. Parsons, Reginald Belfield and William Chapman, London, England. App. filed Nov. 16, 1900. The yoke sustaining the conduit and rails has special strengthening webs and the brace between the rail and slot rail has an intermediate support on the yoke.

776,682. PLOW FOR ELECTRICALLY PROPELLED VEHICLES; Richard C. Parsons, Reginald Belfield and Wm. Chapman, London, England. App. filed Feb. 20, 1902. The plow is connected with its support by soft metal rivets that will be sheared off and save the other parts from breaking, should the plow become obstructed.

776,695. SUSPENSION CLAMP FOR ELECTRIC CONDUCTORS; Ed-



776,709.—Searchlight System.

ward L. Schwartz and Albert G. Ward, Belleville, Ill. App. filed April 10, 1903. A bracket adapted to be nailed to a tree or post having a permanent clamp for the wire and a temporary seat upon which the wire may rest while the clamp is being adjusted.

776,705. INDUCTION COIL; Richard Varley, Providence, R. I. App. filed Dec. 30, 1903. The coil has two vibrators, both of which are active at the same time, but only one affects the primary circuit, the motions of the other meanwhile serving to clean its contacts.

776,709. SEARCHLIGHT SYSTEM; William O. Webber, Boston, Mass. App. filed Jan. 6, 1904. A number of searchlights are installed at different points and provided with masks so that different combinations of them can be unmasked from a central station to detect the location of an enemy, without permitting the enemy to find his bearings.

776,735. TROLLEY WIRE CLAMP AND FEED WIRE SUPPORT; Thomas A. Furniss, Canonsburg, Pa. App. filed Sept. 7, 1904. One clamping device sustains the trolley and feed wires side by side.

776,789. INSULATOR; Fred M. Locke, Victor, N. Y. App. filed Nov. 16, 1903. Two inverted cup-shaped insulator sections nested together and formed with annular flanges in planes one above the other and at right angles to the axis.

776,803. TROLLEY OPERATED ELECTRIC SWITCH; John J. Ruddick, Newton, Mass. App. filed March 28, 1904. The switch is mounted above the trolley wire and actuated when the pressure of the trolley wheel lifts the wire.

776,826. ELECTRIC PROPULSION OF CARS OR THE LIKE; Orestez H. Caldwell, Indianapolis, Ind. App. filed Feb. 15, 1904. The car is propelled by the attraction of successively arranged magnets in the road-bed acting upon a polarized magnet on the car.

776,843. STREET CAR SIGNAL; James H. Howard, Kansas City, Kan. App. filed Sept. 27, 1904. A signal placed at the rear of a car to be actuated by the motorman to indicate to persons crossing the track behind the car, that another car is approaching on the other track.

776,849. ELECTRIC SWITCH; William Kingsland, London, England. App. filed March 7, 1904. Details.

776,855. ELECTRIC SWITCH; Ellsworth a La Har, New Britain, Conn. App. filed July 30, 1904. Details.

776,866. ELECTRICAL MEASURING INSTRUMENT; Frank W. Roller, Plainfield, N. J. App. filed May 15, 1902. A device for testing the relative resistance of different portions of a conductor, comprising a contact bar carrying three terminals, each adapted to engage the conductor, one of the terminals being yieldingly mounted; circuits from the various terminals include mechanism for comparing the resistances of the different portions of the conductor.

776,876. APPARATUS FOR WIRELESSLY TRANSMITTING ELECTRICAL ENERGY; Daniel W. Troy, Montgomery, Ala. App. filed Oct. 26, 1904. A capacity area connected in series through a condenser and a source of electricity to ground and being otherwise insulated.

776,878. CURRENT CONTROLLING SYSTEM; William R. Whitehorne, Bethlehem, Pa. App. filed Sept. 22, 1904. A system in which the speed of the motor is controlled by the number of storage battery cells employed in circuit with it, means being provided to connect certain cells interchangeably and thereby having available always a fully charged battery.

776,895. CONTROLLER; John P. Durkin, Philadelphia, Pa. App. filed Oct. 15, 1904. Details of a catch for regulating the movements of the controller handle from step to step.

776,954. TROLLEY POLE; Charles H. Spangler, Atlanta, Ga. App. filed Feb. 14, 1903. Details.

776,960. TELEPHONE TRANSMITTER; George W. Talley, Atlanta, Ill. App. filed May 19, 1903.

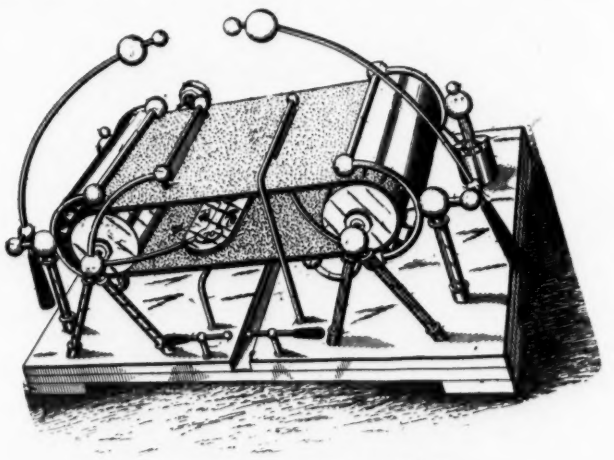
776,970. CIRCUIT CHANGER; James C. Waldo, Sharpsburg, Pa. App. filed Oct. 19, 1903. A circuit changer comprising a ratchet wheel actuated by pawls on opposite sides, moved by electro-magnets, with suitable locking devices.

776,985. COMBINATIONAL TELEGRAPH INSTRUMENT; Francisco G. Barbosa, Limon, Costa Rica. App. filed Dec. 18, 1903. An instrument constructed to serve either as a key, a sounder, a repeater, or a switch, as desired.

776,997. STATIC ELECTRIC MACHINE; Juan G. Holguin Burboa, Chihuahua, Mex. App. filed Aug. 13, 1903. The machine comprises two cylinders over which a flexible belt of insulating material passes; suitable friction mechanism and connections are arranged to engage the belt.

776,998. ELECTRIC SWITCH; Thomas A. Cameron, Philadelphia, Pa. App. filed June 14, 1904. A switch controlling an alarm circuit is held in open position by the tension of a cord ramifying through a certain protected space; severing the cord by fire or otherwise releases a switch and gives the alarm.

777,014. APPARATUS FOR TRANSMITTING AND RECEIVING SIGNALS; Reginald A. Fessenden, Allegheny, Pa. App. filed March 29, 1901. A system for utilizing the energy of electro-magnetic waves, including a number of wave-responsive devices at the same station together with means for putting the latter out of operative relation to the former successively for a predetermined period.



776,997.—Static Electric Machine.

777,034. CONTROLLING DEVICE FOR ELECTRICALLY PROPELLED VEHICLES; Oskar Lasche, Berlin, Germany. App. filed Nov. 4, 1901. The object is to enable all or any of the motors to be cut out wherever required by means of automatic mechanism operating independently of any interference on the part of the motorman, the motors being thrown into and out of circuit in accordance with the load.

777,046. THERMOSTAT FOR ELECTRIC CIRCUITS; James P. Robertson, North Sydney, New South Wales, Australia. App. filed Oct. 7, 1903. Buckling diaphragms are actuated by the heat of the thermostat to change the circuit.

777,049. TROLLEY WHEEL GUARD FOR ELECTRIC WIRES; John L. Sullivan, Warren, R. I. App. filed April 19, 1904. One arm of the harp is pivoted and carries a guard-wheel which normally stands above the trolley wheel and holds the latter on the wire.

777,052. TROLLEY GUARD; George W. Watson, Kearney, N. J. App. filed Feb. 26, 1904. Details.

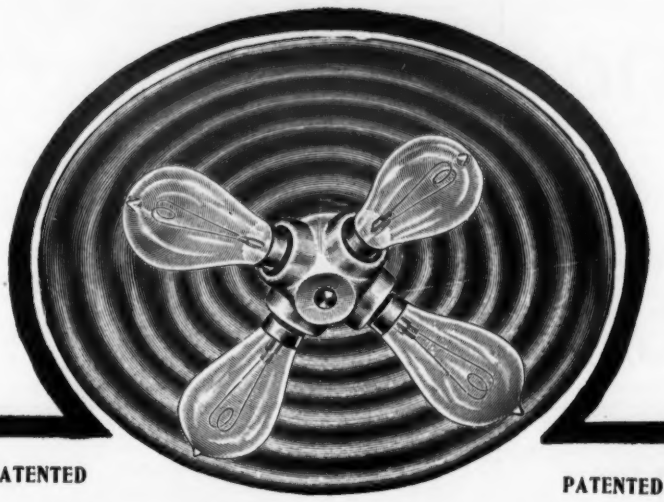
The Moonlight Tables for 1905

appeared
in last
week's issue in
supplement
form

Duplicate Copies May Be Obtained at 10 cents each

Electrical World and Engineer

114 Liberty Street New York



PATENTED PATENTED

PORCELAIN CLUSTER

REQUIRES NO WIRING AND NO SOCKETS

Lamps screw into receptacles concealed in cluster body.

It fastens to ceiling like a receptacle or rosette, or it can be extended from the ceiling in the ordinary way.

Connects either cleat, moulding or concealed fashion.

Made only for four or five Edison or T.-H. lamps.

FARIES M'F'G CO.

DECATUR, ILL. (3)

Half a Man Half a Salary

The half-sized salary goes to the man who has but half developed his abilities. If you are earning but half what you need, we can qualify you for promotion in your present work or prepare you for a more congenial position and better salary. We are doing it right in your own district every day for others, to whom we can refer you.

The I. C. S. method of training by mail is the means by which thousands of ambitious people have advanced in place and salary.

We can qualify you, in your spare time, for a better position or an increased salary. We have done it for others, we can do it for you. Decide today to better your condition —then let us help you.

Mark **X** before the position that interests you, fill in the coupon and send it to us. We will send you full particulars.

International Correspondence Schools
Box 818, Scranton, Pa.

Please send me the free booklet, "1001 Stories of Success," and explain how I can qualify for position marked X, below.

Electrical Engineer	Architect
Electrician	Chemist
Mech. Draftsman	Ad Writer
Machine Designer	Show-Card Writer
Mechanical Engineer	Bookkeeper
Municipal Engineer	Stenographer
Telephone Engineer	French } With
Stationary Engineer	German } Edison
Civil Engineer	Spanish } Phonograph

*Name*_____

*St. & No.*_____

*City*_____ *State*_____

DOBLE TANGENTIAL WATER WHEELS

ARE SUPERIOR IN DESIGN, MATERIALS, WORKMANSHIP, EFFICIENCY AND DURABILITY

Write for our Bulletins Nos. 5 and 6; they contain data and tables of value to engineers

ABNER DOBLE COMPANY

ENGINEERS

ESTABLISHED 1850 SAN FRANCISCO, U. S. A.

CLASSIFIED INDEX—*Continued from Page 34.*

REFRIGERATING MACHINERY.
Vilter Mfg. Co.

REPAIRING.
Chicago Edison Co.
Elliott Bros. Elec. Co.
Gregory Electric Co.
Heck, Louis.
Waterbury & Co.

RESISTANCE UNITS.
Electric Controller & Supply Co.
Simplex Electric Heating Co.
Ward Leonard Elec. Co.

RHEOSTATS.
American Electric & Controller Co.
Cutler-Hammer Mfg. Co.
General Incandescent Arc Light Co.
Globe Elec. Controller Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.
Wirt Electric Co.

ROSETTES.
Hart Mfg. Co.
Paiste Co., H. T.
Pass & Seymour, Inc.
Sears, Henry D.
Yost Elec. Mfg. Co.

SAL AMMONIAC.
Allen Co., L. B.
Klipstein & Co., A.
Roessler & Hasslacher Chem. Co.

SAWS, HACK.
Smith, Hemenway & Co., Corp.

SCHOOLS AND COLLEGES.
American School of Correspondence.
Electrical Engineer Inst. of Correspondence Inst.
International Correspondence Schools.
Michigan College of Mines.

SCREWS.
National-Acme Mfg. Co.

SEARCHLIGHTS.
Bogue, Charles J.
Carlisle & Finch Co.
Fort Wayne Electric Works.
Rushmore Dynamo Works.

SECOND-HAND APPARATUS.
Bender, George.
Garvin Mch. Co.
Gregory Electric Co.
Jordan Bros.
Richter, Eugene.
Rossiter, MacGovern & Co.
Ruel, A. J.
Station Equipment Co.
Thompson, Jr., Joseph H.
Thompson-Bonney Co.

SHADE HOLDERS.
J-E-M Shade Holder Co.

SIGN LAMPS.
Phelps Co.

SIGNS, ELECTRIC.
Electric Motor & Equipment Co
Federal Elec. Co
Reynolds Elec. Flasher Mfg. Co.

SIGN, LETTERS.
Electric Motor & Equipment Co.
Hermann Mfg. Co.

SOCKETS.
Benjamin Elec. Mfg. Co.
Federal Electric Co.
General Electric Co.
Paiste Co., H. T.
Pass & Seymour, Inc.
Yost Electric Mfg. Co.

SOLDERING FLUX.
Allen Co., L. B.
Crescent Company.

SOLDERING IRONS—ELEC.
American Elec'l Heater Co.
Simplex Electric Heating Co.

SOLENOIDS.
Schureman & Co., J. L.

SPECIALTIES.
Lundin Electric & Mch. Co.

SPEED INDICATORS.
Schaeffer & Budenberg.
Warner Instrument Co.

SPRINGS.
Barnes Co., Wallace.
Cary Spring Works.
Dunbar Bros.
Manross, F. N.

STEEL.
American Bridge Co.
Leslie & Co., A. C.

STEEL PINS.
Locke Insulator Mfg. Co.

STOKERS.
American Stoker Co.
Westinghouse, Church, Kerr & Co.

STOPPERS.
McCullough-Dalzell Crucible Co.

SUPPLIES, ELECTRIC RAILWAY.
Brush Elec'l Engineering Co.
General Electric Co.
Johns-Manville Co., H. W.

SUPPLIES, GENERAL ELECTRICAL.
Bissell & Co., F.
Central Electric Co.
Doubleday-Hill Elec. Co.
Electric Appliance Co.
Electrical Equip. & Supply Co.
General Electric Co.
Hall, William Albert.
Kilbourne & Clark Co.
Manhattan Elec'l Supply Co.
Ostrander & Co., W. R.
Stuart-Howland Co.
Universal Electrical Wks.
Wesco Supply Co.
Western Electric Co.

SUPPLIES, TELEPHONE.
Bissell Co., F.
Holtzer-Cabot Elec. Co.
Kellogg Switchboard & Supply Co.
North Electric Co.
Plummer, Ham & Richardson.
Russell-Tomlinson Elec. Co.
Sterling Electric Co.
Yonkers Specialty Co.

SWITCHES, CEILING.
Sorensen, P.

SWITCHES, CLOCK.
Bissell Co., F.
Crescent Company.
Kilbourne & Clark Co.

SWITCHBOARDS.
Allegemine Elektricitats Gesellschaft.
American Elec. Telephone Co.
Anderson Mfg. Co., A. & J. M.
Bissell Co., F.
Bossert Electric Const. Co.
British Thomson-Houston Co.
Electro-Dynamic Co.
General Incandescent Arc Light Co.
Hill & Co., W. S.
Johnson & Morton.
Kellogg Switchboard & Supply Co.
La Roche Co., F. A.
Muralt & Co.
Nalder Bros. & Thompson, Ltd.
North Electric Co.
Sterling Electric Co.
Sundh Electric Co.
Switchboard Mfg. Co.
Trumbull Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Waterbury & Co.

SWITCHES, ETC.
Allgemeine Elektricitats Gesellschaft.
Anderson Mfg. Co., A. & J. M.
Bissell & Co., F.
Bossert Elec. Const. Co.
Chase-Shawmut Co.
Cook, Frank B.
Cutter Electrical & Mfg. Co.
Electric Controller & Supply Co.
Electro-Dynamic Co.
Fort Wayne Electric Works.
General Electric Company.
General Incandescent Arc Light Co.
Hart Mfg. Co.
Hill Elec. Co., W. S.
Johnson & Morton.
La Roche Co., F. A.
Muralt & Co.
Sorensen, P.
Sterling Electric Co.
Sundh Electric Co.
Switchboard Mfg. Co.
Trumbull Elec. Mfg. Co.
Waterbury & Co.

TABLET BOARDS.
Bossert Elec. Const. Co.
Johnson & Morton.
La Roche Co., F. A.
Trumbull Elec. Mfg. Co.

TACHOMETERS.
Schaeffer & Budenberg.

TAPE.
American Electrical Works.
Electric Appliance Co.
Hope Webbing Co.
Manhattan Electrical Supply Co.
Mica Insulator Co.
Okonite Co.

TAPS AND DIES.
Carpenter Tap & Die Co., J. M.
Pratt & Whitney Co.

TELEPHONES.
American Bell Telephone Co.
American Electric Telephone Co.
Atwater-Kent Mfg. Co.
Automatic Elec. Co.
Bissell Co., F.
Conn. Telephone & Elec. Co.
Couch Co., S. H.
Edmonstone Co.
Holtzer-Cabot Elec. Co.
International Tele. Mfg. Co.
Kellogg Switchboard & Supply Co.
Manhattan Elec'l & Supply Co.
Murdock, H. D.
North Electric Co.
Plummer, Ham & Richardson.
Russell-Tomlinson Elec. Co.
Sterling Electric Co.
Stromberg-Carlson Tele. Mfg. Co.
Viaduct Mfg. Co.
Western Electric Co.

TELEPHONE SERVICE.
Bell Telephone Co. of Philadelphia.
New York Telephone Co.

TELPHERAGE.
United Telpherage Co.

THEATRE DIMMERS.
Cutler-Hammer Mfg. Co.
Globe Elec. Controller Co.
Simplex Electric Heating Co.
Universal Electrical Works.
Ward Leonard Electric Co.
Wirt Electric Co.

TIES.
Phelan, D. W.
Sterling & Son, W. C.
Strock, S. C.

TESTING, ELECTRICAL.
Electrical Testing Laboratories.

TIME SWITCH.
American Electric Sign Co.

TOGGLE BOLTS.
Yonkers Specialty Co.

TOOLS, CONSTRUCTION.
Cincinnati Tool Co.
Hall, William Albert.
Klein & Sons, Mathias.
Smith, Hemenway & Co., Corp.

TOOL GRINDERS.
Barnes Co., B. F.

TOOLS, LINEMEN'S.
Bissell Co., F.
Cincinnati Tool Co.
Klein & Son, Mathias.
Smith, Hemenway & Co., Corp.
Utica Drop Forge & Tool Co.

TRACTION SYSTEMS.
General Electric Co.
Muralt & Co.

TRANSFORMERS.
Allgemeine Elektricitats Gesellschaft.
American Transformer Co.
Central Electric Co.
Crawfordsville Elec. Co.
Devine, J. P.
Fort Wayne Electric Works.
General Electric Co.
General Inc. Arc Light Co.
Gregory Electric Co.
Lakon Co.
Moloney Elec. Co.
Muralt & Co.
National Elec. Co.
New York & Ohio Co.
Thordarson, C. H.
Wagner Electric Mfg. Co.
Wesco Supply Co.
Westinghouse Electric & Mfg. Co.

TUBULAR DISPATCH.
United Telpherage Co.

TURBINES, STEAM.
General Electric Co.
Westinghouse Machine Co.

VALVES.
Crane Co.
Crosby Steam Gage & Valve Co.
Jenkins Bros.
Lunkenheimer Co.

VISES.
Utica Drop Forge & Tool Co.

VOLTAGE REGULATORS.
Bissell & Co., F.
Portland Co.

VULCABESTON.
Johns-Manville Co., H. W.

VULCANIZED FIBRE.
Vulcanized Fibre Co.

WATER MOTORS.
Rosenberg Co., A.

WATCHES, NON-MAGNETIC.
Becken, A. C.

WATER WHEELS AND TURBINES.
Doble Co., Abner.
Leffel & Co., James.
Pelton Water Wheel Co.
Risdon-Alcott Turbine Co.
Smith Co., S. Morgan.

WATER WHEEL GOVERNORS.
Doble Co., Abner.
Holyoke Machine Co.
Lombard Governor Co.
Risdon-Alcott Turbine Co.
Sturgess Governor Eng'ring Co.
Woodward Governor Co.

WEBBING.
Hope Webbing Co.

WINDING MACHINERY.
American Insulating Machinery Co.

WIRELESS TEL. INSTRUMENTS.
National Elec. Signalling Co.

WIRES AND CABLES.
American Elec'l Works.
Atlantic Insulated Wire & Cable Co.
Bishop Gutta Percha Co.
Bridgeport Brass Co.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
Chicago Insulated Wire Co.
Connolly Bros., Ltd.
Crescent Insulated Wire & Cable Co.
Devine, J. P.
Driver-Harris Wire Co.
Electric Appliance Co.
Hall, William Albert.
Hazard Mfg. Co.
Indiana Rubber & Ins. Wire Co.
India Rubber & G. P. Ins. Co.
Moore, A. F.
National Conduit & Cable Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Roebling's Sons Co., J. A.
Safety Insulated Wire & Cable Co.
Simplex Electrical Co.
Standard Underground Cable Co.
Waterbury & Co.

ELECTRICAL WORLD AND ENGINEER

is the pioneer electrical journal in export as in all other matters—IT GOES ALL OVER THE WORLD.

ALLEN

Our free advertising plan helps dealers sell

We get right into harness with the dealer—advertise for him—make people come to his store and ask for

The Allen Soldering Stick

It's the best flux ever made. We'll send a big free sample to dealers or those who *send* their *dealer's name. No name, no sample.*

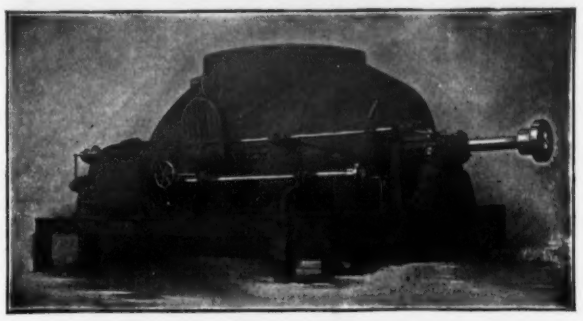
L. B. ALLEN CO., Inc.
1332 Columbia Ave., CHICAGO

ELEC. WORLD & ENG'R

PAIR

McCORMICK TURBINES

4000 H.P., 72 ft. head, arranged to drive generator and a single turbine to drive exciter. Five settings built for the Hudson River Water Power Company for their Spier Falls plant and 14 pairs 51" for their plant at Mechanicsville, N. Y. *Write for catalogue, if contemplating purchase of turbines.*



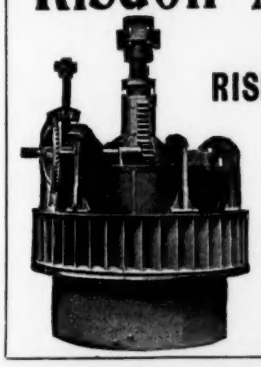
S. MORGAN SMITH CO., York, Pa., U.S.A. BOSTON OFFICE 176 Federal Street

E E S C
Everything Electrical
ELECTRICAL EQUIPMENT & SUPPLY CO.
215½ 4th Avenue PITTSBURG, PA.

NEW IDEAS
Distinctive Merits
are found in the Lundin specialties
Our Circular makes interesting reading
THE LUNDIN ELECTRIC & MACHINE CO. (Inc.)
176 FEDERAL STREET, BOSTON, MASS.

If you do not know who makes what you want to buy, consult the advertising pages of ELECTRICAL WORLD AND ENGINEER.

Risdon-Alcott Turbine Co.
MOUNT HOLLY NEW JERSEY, U. S. A.



RISDON CELEBRATED TURBINE
ALCOTT HIGH DUTY TURBINE
ON HORIZONTAL or VERTICAL SHAFTS

These Turbines are recognized as the most effective Water Wheels made.

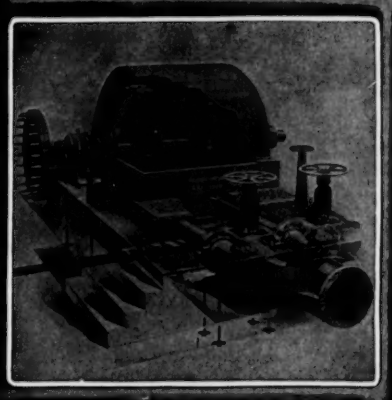
Your inquiries should come direct to us for this class of machinery.

ELECTRICAL WORLD AND ENGINEER.....

has the largest paid circulation of any electrical weekly paper published, and it has the

BEST CLASS OF READERS

PELTON WATER WHEELS



Pelton Water Wheel Company
130 Main St., San Francisco
141 Liberty St., New York

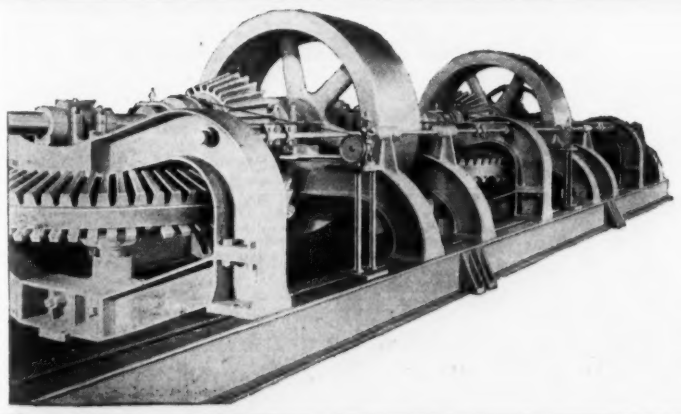
Pelton Wheels on the Island of Mauritius

When Portuguese adventurers discovered the Mauritius Island in the Indian Ocean, east of Madagascar, in 1505, it was little thought that 400 years later real civilization would begin by the installation of Pelton Water Wheels.

This island is now a colony of Great Britain which practically controls its supplies, yet when it was desired to install a permanent electric plant, Pelton Wheels, of American manufacture, were selected. These wheels drive generators furnishing electric power for manufacturing and producing sugars, rice, maize, rare and valuable woods, etc.

Were it not for the Pelton's excellent and economical service, it is likely that this contract would have gone to European wheels, for the distance and expense of installation from San Francisco was considerable.

A valuable book on hydraulics mailed free.



SAMSON TURBINE

Aside from TURBINE WATER WHEELS we build a complete line of TRANSMISSION MACHINERY in the way of GEARS, SHAFTS, BRIDGE-TREES, BEARING BOXES, PULLEYS, ETC.

JAMES LEFFEL & CO.
308 Lagonda St., Springfield, Ohio, U. S. A.

SATISFIED CUSTOMERS

are those who are buying such specialties from us as:
Packard Lamps and Transformers.
Adams-Bagnall Arc Lamps.
"O. K." Weatherproof Wire.
Peerless and Paranite Rubber-Covered Wire.
Brunt Porcelain.
Ansonia Magnet Wire.
Circular Loom, Etc., Etc.

ELECTRIC APPLIANCE COMPANY
Chicago and San Francisco

STERLING BLACK PLASTIC INSULATOR

One hundred days' continuous baking at 180° F. will not make it brittle. Water Repellent. Oil Proof.

THE STERLING VARNISH CO., PITTSBURG, PA.

Electrical Testing Laboratories

Electrical and Photometrical Standardization.
Resistance, Conductivity and Insulation Tests.
Calibration of Measuring Instruments.
Arc and Incandescent Lamp Tests.
Special Investigations.
Secondary Standards of Candle-power Furnished.

546 East 80th Street, New York City

"P-K" PANEL BOXES AND CUTOUTS

"P-K" Panel Cut-Out.

(Cut is ½ size.)
2 Wire 25 amp. Main.

A new line that will revolutionize panel-box building.

These are wooden Panel-boxes with capacities up to 20 circuits, with solid oak fronts, quarter-oak doors, and can be delivered at your door for less than your carpenter can make them.

WRITE US TO-DAY FOR CIRCULAR AND PRICES.

H. T. PAISTE CO., Philadelphia, Pa.
"The Leading Specialty Manufacturers."

Sunlight Reflector

LOW PRICES
BEST QUALITY
PROMPT DELIVERY
are the inducements we offer

SUNLIGHT REFLECTOR CO.
141 COURT STREET, BROOKLYN, N. Y.

Yost Specialties

Sockets
Wall Sockets,
Weatherproof Sockets,
Rosettes,
Receptacles,
Cord Adjusters

Catalogue for the asking

The Yost Electric Mfg. Co.
TOLEDO, OHIO

ELECTRIC LIGHTING OUTFITS

READY FOR USE

Very popular for electric lighting decorations and especially adapted to the lighting of Christmas trees.

SAFE, SIMPLE AND CONVENIENT

EDISON DECORATIVE AND MINIATURE LAMP DEPT.

General Electric Company

Made in Four Sizes
8 lights, 16 " , 24 " , 32 " } $5.00 and upward

HARRISON, N. J.

I-T-E Circuit Breakers

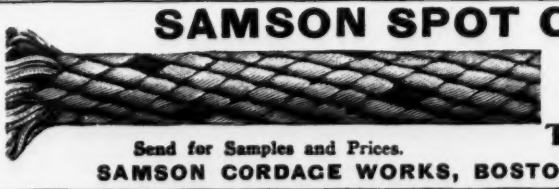
Interconnected, 2200 Volts, A. C.

For boosters and motor generators it is becoming more the practice to mechanically inter-connect Circuit Breakers so that the opening of one will cause the opening of another or several others.

THE CUTTER CO.

Circuit Breaker Engineers and Manufacturers
PHILADELPHIA

SAMSON SPOT CORD FOR..



Arc Light
AND
Trolley Cord

Send for Samples and Prices.
SAMSON CORDAGE WORKS, BOSTON, MASS.

STAR
INCANDESCENT
LAMPS
THE STANDARD ELECTRICAL MFG. CO., Niles, O.